Post-diagnosis sedentary behaviour and health outcomes in cancer survivors: A systematic review and meta-analysis

Journal:	*Cancer*
Manuscript ID	Draft
Wiley - Manuscript type:	Review Article
Date Submitted by the Author:	n/a
Complete List of Authors:	Swain, Christopher; Cancer Council Victoria, Cancer Epidemiology Division Nguyen, Nga; Cancer Council Victoria, Cancer Epidemiology Division Eagles, Tobyn; Cancer Council Victoria, Cancer Epidemiology Division Vallance, Jeff; Athabasca University, Faculty of Health Disciplines Boyle, Terry; University of South Australia, School of Health Sciences Lahart, Ian; University of Wolverhampton, Faculty of Education Health & Wellbeing Lynch, Brigid; Cancer Council Victoria, Cancer Epidemiology Division
Keywords:	Sedentary behavior, Sitting, Screen time, Neoplasms, Survivors, Mortality, Survivorship

Title:

Post-diagnosis sedentary behaviour and health outcomes in cancer survivors: A systematic review and meta-analysis

Running title:

Sedentary behaviour and health outcomes

Authors:

Christopher T.V. Swain, PhD;[1] Nga H. Nguyen, PhD;[1] Tobyn Eagles, MSc;[1] Jeff K.Vallance, PhD;[2] Terry Boyle, PhD;[3] Ian Lahart, PhD;[4] Brigid M. Lynch, PhD.[1, 5, 6]

Institutions:

1. Cancer Epidemiology Division, Cancer Council Victoria, Australia

2. Faculty of Health Disciplines, Athabasca University, Canada.

3. School of Health Sciences, University of South Australia, Australia

4. Faculty of Education Health & Wellbeing, University of Wolverhampton, United Kingdom

5. Melbourne School of Population and Global Health, University of Melbourne, Australia

6. Physical Activity Laboratory, Baker Heart and Diabetes Institute, Melbourne, Australia

Corresponding author's contact information:

Chris Swain. Cancer Epidemiology Division, Cancer Council Victoria, 615 St Kilda Rd, Melbourne, Vic 3004, Australia; email: chris.swain@cancervic.org.au; phone: +61 3 9514 6217.

Funding statement:

Jeff Vallance is supported by the Canada Research Chairs program. Brigid Lynch is supported by a fellowship from the Victorian Cancer Agency (MCRF18005).

Conflict of interest statement:

The authors have no conflict of interest.

Acknowledgements:

Nil

Precis:

Higher post-diagnosis sedentary behaviour is associated with increased all-cause and colorectal cancer specific mortality in cancer survivors. Consistent evidence for an association between sedentary behaviour and patient reported or anthropometric outcomes was not identified.

Number of text pages: 25 (from abstract to figure legends)

Number of tables: 1

Number of figures: 5

Number of supporting files: 6

PROSPERO registration ID: CRD42019124328

Abstract

High levels of sedentary behaviour may negatively impact health outcomes in cancer survivors. A systematic review and meta-analysis was performed to clarify whether post-diagnosis sedentary behaviour is related to survival, patient-reported, and anthropometric outcomes in cancer survivors. Ovid Medline, EMBASE, CINAHL, and SPORTDiscus were searched from inception to June 2019. Studies of adults who had been diagnosed with cancer that examined the association between sedentary behaviour and mortality, patient reported, or anthropometric outcomes were eligible for inclusion. Fixed and random effects meta-analysis were performed to estimate hazard ratios (HR) for the highest compared to lowest levels of sedentary behaviour for all-cause and colorectal (CRC) specific mortality outcomes. The ROBINS – E tool and GRADE system were used to assess the risk of bias (ROB) and strength of evidence, respectively. Thirty three eligible publications (29 separate studies) from a total of 3,569 identified articles were included in the review. A higher level of post-diagnosis sedentary behaviour was associated with increased risk of all-cause mortality (HR, 1.22; 95% CI, 1.06, 1.41; I^2, 33.8%) as well as CRC specific mortality (HR, 1.53, 95% CI, 1.14, 2.06; I^2, 0.0%). No clear or consistent associations between sedentary behaviour and patient-reported or anthropometric outcomes were identified. ROB in individual studies ranged from moderate to serious and the strength of evidence ranged from very low to moderate. While avoiding high levels of sedentary behaviour following a cancer diagnosis may improve survival, further research is required to help clarify whether the association is causal.

Key words:

Sedentary behavior; Sitting; Screen time; Neoplasms; Survivors; Mortality; Survivorship

Introduction

As cancer and its associated treatments lead to considerable detriments in physical and mental health, identifying ways in which the health of the growing population of cancer survivors can be improved is essential.[1] Sedentary behaviour, defined as any waking behaviour characterised by an energy expenditure ≤1.5 METs while in a sitting, reclining or lying posture,[2, 3] has been proposed to be a risk factor for several health outcomes in cancer survivors.[4] The continuum of evidence, from experiments in animals to large population studies, has demonstrated higher volumes of sedentary behaviour to be associated with a range of negative physiologic effects; some effects are thought to be distinct from not performing sufficient moderate- to vigorous-intensity physical activity (MVPA).[5-8] For instance, in persons that are cancer free at baseline, increased sedentary time has been associated with higher incidence of cardiovascular disease,[9] metabolic disorders,[9] several types of cancer,[10] and higher all-cancer as well as all-cause mortality, after adjustment for potential confounding factors, including MVPA.[11] Sedentary behaviour in cancer survivors appears high, with accelerometer-based assessment indicating that, on average, cancer survivors spend two thirds of their waking hours sedentary.[4] Given the above and the established links between other post-diagnosis lifestyle behaviours and health outcomes in cancer survivors,[12] it is reasonable to expect that high levels of sedentary behaviour after diagnosis will, in turn, lead to more negative health outcomes within these populations.

Findings from studies to date have not provided clear evidence regarding the impact of high levels of post-diagnosis sedentary behaviour on health outcomes in cancers survivors. Therefore, the objectives of this review were to determine whether post-diagnosis sedentary behaviour is associated with: 1) all-cause mortality, cancer-specific mortality, event-free survival, and cancer progression in people diagnosed with cancer; 2) patient-reported outcomes (such as quality of life (QOL) and fatigue); and 3) anthropometric outcomes in

cancer survivors. This review also sought to evaluate the quality of the evidence currently available.

Methods

This systematic review and meta-analysis is structured in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[13] The review was preregistered via PROSPERO (ID: CRD42019124328).

Search strategy

Relevant publications were identified through systematic searches of the following four electronic databases up until June 16th, 2019: MEDLINE (Ovid), SPORTDiscus, EMBASE, and CINAHL. The search strategy included a combination of controlled vocabulary (e.g. Medical Subject Headings of the National Library of Medicine) and free text terms (**Supplement 1**). In addition, reference lists from comprehensive reviews and identified studies were hand-searched for possible references not otherwise found and a forward citation search was performed on Google Scholar. No date or language limits for publication were set.

Inclusion and exclusion criteria

Peer reviewed cohort, case-control, cross-sectional, or intervention studies were included if they examined the association between post-diagnosis sedentary time and mortality and cancer progression (e.g. all-cause mortality, cancer specific mortality, recurrence), patient-reported outcomes (e.g. QOL, depression, fatigue, pain), or anthropometric measures (e.g. body mass index [BMI], waist circumference [WC], lean mass), in adult (≥18 y) male and female cancer patients and survivors. Sedentary behaviour could be assessed either via self-report or device. Studies where the exposure of interest was very low physical activity,

defined sedentary behaviour as not meeting MVPA guidelines, or did not distinguish between waking and sleeping were excluded. Given the potential for several confounding factors to influence the associations between sedentary behaviour and the outcomes of interest, observational studies that performed only univariable analysis on exposure-outcome relationships were excluded.

Data extraction

Each title and abstract of all studies returned by the systematic search were independently checked by two reviewers (C.S. reviewed all and I.L./J.V. reviewed half each). Studies that were clearly not relevant were excluded. Two reviewers (C.S. and T.E.) assessed the full texts of all remaining studies to determine whether the selection criteria were met. Disagreements were resolved through discussion, with a third reviewer (B.L.) available to adjudicate when necessary. Data were extracted independently by reviewers (C.S. and T.E.) using a standardised, pre-piloted form. Extracted information included: study details (author, year, design, country, and cohort); participant information (*n*, age, and sex); cancer type and stage; sedentary behaviour definition, domain (e.g. sitting time, TV viewing), and assessment method (e.g. self-report questionnaire, accelerometer assessment); outcome definition and assessment method; effect estimates (e.g. hazard ratio [HR] and 95% confidence interval [CI]); and confounders adjusted for.

Risk of bias and quality assessment

To assess risk of bias (ROB) in prospective cohort, case-control, and cross-sectional studies, the preliminary version of the Risk Of Bias In Non-randomized Studies – of Exposures (ROBINS-E) tool was used.[14] This is a multi-item tool that assesses potential bias present due to confounding, participant selection, classification of exposures, departures from exposures, missing data, measurement of outcomes, and selection and reporting of results. Studies are

given a ROB judgement (low, moderate, serious, critical, or no information) for each of these domains. A directed acyclic graph was created for important confounders (**Supplement 2**). An overall ROB judgement of low (i.e. study is judged to have low ROB for all domains), moderate (i.e. the study is judged to have low or moderate ROB for all domains), serious (the study is judged as serious but not critical in at least one domain), critical (the study is judged to be have critical ROB in at least one domain), or no information (i.e. no indication that the study is serious or critical risk and information is lacking in at least one domain) is assigned to each individual study. To rate the quality of evidence, and the strength of any findings generated, the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system was employed.[15] While extensive guidelines outlining the application of this system have been published elsewhere, briefly, the quality of evidence for a particular exposure-variable relationship is given a score between very low to high based on the type of studies available, as well as their ROB, the consistency and precision of findings, directness, publication bias, effect estimates, dose-response relationships, and influence of confounding factors.[15]

Data synthesis and meta-analysis

For all outcomes, extracted data were summarised and presented descriptively. Meta-analysis was used to compare the highest to the lowest (reference) category of sedentary behaviour for outcomes that were consistently defined, examined in studies of similar design, and that used analysis that facilitated statistical combination. Statistical heterogeneity between studies was tested using the Q statistic and quantified by the I^2 statistic. Fixed effects meta-analysis was performed when heterogeneity was low ($I^2 < 20\%$), otherwise random effect meta-analysis was performed. Publication bias was assessed by visual inspection of funnel plots and statistically using Egger's regression asymmetry test. Meta-analysis was performed with

Comprehensive Meta-Analysis software (CMA, version 3). Harvest plots were generated for outcomes not included in meta-analysis.[16]

Results

A summary of the results of the literature search is presented in **Figure 1.** The literature search returned a total of 3,569 articles. Following duplicate removal (*n*=1,383) and a review of title and abstracts (*n*=2,186), 107 full texts were screened. Seventy-four articles were excluded following full text screening because they did not meet the criteria for publication type (*n*=5), research question or study design (e.g. *n*=19), population (*n*=9), exposure (*n*=19), outcomes (n=18), statistical analysis (*n*=3), or the data had already been included (this was a second publication from the same dataset) *(n=1)*. A list of excluded full texts with reasons is provided in **Supplement 3.** The final review contained 33 original research articles from 29 separate studies. Nine studies addressed mortality,[17-25] 16 studies (19 publications) addressed patient reported outcomes,[26-44] and five addressed anthropometric outcomes.[45-49] No studies reported data for sedentary behaviour and cancer progression or recurrence. Meta-analysis was performed on all-cause and colorectal cancer (CRC) specific mortality only. It was not performed on other outcomes due to the number of studies available, differences in study design, and statistical output.

Insert Figure 1 around here

Risk of bias

The ROB judgements are presented in **Supplement 4**. Eight of nine mortality studies were judged to contain moderate ROB, with one study judged to contain a serious ROB as it did not account for education or other socioeconomic confounders when examining workplace sedentary behaviour.[21] All studies that examined patient reported outcomes were judged to

have a serious ROB, primarily due to the nature of the outcome assessment (i.e. a subjective outcome measure completed by individuals aware of their own sedentary behaviour). Five of these studies were also judged as having serious ROB for not controlling for all important confounding domains. Two studies that reported anthropometric outcomes scored a serious ROB as they relied on self-reported outcome assessment, and three scored serious as they did not control for all important confounding domains. All cross-sectional studies scored serious risk for exposure classification as exposure assessments did not precede outcome assessment.

Study characteristics

A summary of study characteristics is provided in **Supplement 5**. The nine studies addressing mortality were prospective in design. The sample size ranged from 580 – 2293 participants, and included patients and survivors of CRC,[18-20, 23] breast,[22] endometrial,[17] hematologic,[24] prostate,[21] and renal cell cancer.[25] All studies assessed sedentary behaviour via self-report, with domains including television viewing time,[17, 18, 22-25] total sitting time,[20] occupational sitting time,[21] and leisure time spent sitting.[19] Every study reported all-cause mortality, six reported cancer specific mortality including CRC,[18-20] prostate,[21] renal,[25] and hematologic.[24] Two studies reported mortality due to cardiovascular disease,[18, 19] and two reported other mortality outcomes,[19, 20] which included non-cancer and non-CVD mortality as well as non-cancer mortality.

Sixteen studies (19 publications) included patient reported outcomes. Six of these studies were prospective in design. Sample sizes ranged from 54 – 1,966 participants, and specific cancers studied consisted of breast[27, 30, 31, 33, 35-37] colon or colorectal,[32, 41-44] lung,[26, 39] prostate,[28, 34] kidney,[38] non-Hodgkin lymphoma,[40] and mixed[29] cancer patients and survivors. Sedentary time was assessed by a device (e.g., accelerometer) in 11 studies[26, 28, 29, 31, 33, 36, 37, 39-44] and by self-report in six.[27, 30, 32, 34, 35, 38] Outcomes included QOL,[26, 28-33, 38, 40, 42-44]

fatigue,[26, 28, 30, 33, 35, 37, 38, 40, 42, 43] depression,[28, 33, 35-37, 39, 41, 43] anxiety,[28, 33, 39, 41, 43] and pain.[27-30, 37]

Five studies, including one prospective and four cross-sectional studies, examined the association between post-diagnosis sedentary time and anthropometric outcomes. The sample size ranged from 103 to 1867, and included adult patients and survivors of breast,[45, 48] colorectal,[49] prostate,[47] and various paediatric cancers.[46] Four studies measured sedentary time using accelerometers and one assessed TV viewing time via self-report. Outcomes included BMI,[45, 46, 48, 49] WC,[45-48] percentage of lean mass (%LM),[46] as well as waist to height ratio (WHR).[46]

Mortality outcomes

Fixed and random effects meta-analyses were used to determine whether post-diagnosis sedentary time was associated with all-cause and cancer specific mortality (**Figure 2**). Compared to those with the lowest level of sedentary time, cancer survivors that accumulated the most sedentary time had a 22% higher all-cause mortality risk (HR, 1.22; 95% CI, 1.06, 1.41; I^2, 34%). This increased to a 28% higher risk after removing one study that assessed occupational sedentary time only[21] (HR,1.28; 95% CI1.14, 1.44; I^2 0%). Similarly, the most sedentary CRC survivors had a 53% higher CRC-specific mortality risk than did the least sedentary (HR, 1.53; 1.14, 2.06; I^2, 0%). Funnel plots did not show any noticeable asymmetry, suggesting no evidence of publication bias, although this judgement was made with only a small number of studies available. In individual studies, there were no statistical or clinically meaningful associations between sedentary time and renal[25] or haematological[24] cancer specific mortality, between occupational sedentary time and prostate cancer specific mortality,[21] or with sedentary time and CVD mortality in cancer survivors identified (**Supplement 7**).[18, 19]

Insert Figure 2 around here

Patient reported outcomes

Results of individual studies investigating the association between sedentary behaviour and patient reported outcomes are presented in **Supplement 6** and in **Figures 3** (QOL and cancer specific concerns), **4** (QOL domains), and **5** (fatigue, depression, anxiety, and pain). In brief, a null association between sedentary behaviour and individual patient reported outcomes was the more common finding.

Insert Figures 3 - 5 around here

Anthropometric outcomes

Associations between sedentary behaviour and BMI or WC are presented in **Figure 3** and **Supplement 6**. One prospective study identified statistically significant, positive associations between TV viewing time and BMI calculated using self-reported height and weight,[49] whereas no cross-sectional associations between sedentary behaviour and BMI or waist circumference identified. Further, in a single study, increasing daily sedentary time by 10% was associated with a decrease in %LM but no change in WhR.

GRADE

Summary of evidence for each outcome is presented in Table 1. As only observational studies were available, the initial grade for all outcomes was low. No outcome met the criteria to be graded up. Each of the patient reported and anthropometric outcomes were graded down to very low, owing to the serious ROB and inconsistent results in individual studies.

Insert Table 1 around here

Discussion

The purpose of this review was to determine whether post-diagnosis sedentary behaviour was associated with health outcomes in cancer survivors. Higher levels of sedentary behaviour were associated with all-cause as well as CRC mortality, although meta-analysis was not possible for any other cancer specific or non-cancer mortality outcomes. There was no clear or consistent evidence to support associations between sedentary behaviour and patient reported outcomes or anthropometry identified via systematic review.

Statistically significant associations between post-diagnosis sedentary behaviour and mortality build upon the previous literature examining the effects of sedentary behaviour on disease risk and mortality in the general population. For instance, a previous meta-analysis documented that higher levels of sedentary behaviour in general population cohorts resulted in a 22% increase risk for all-cause mortality risk, a 15% increase in CVD mortality risk, as well as a 13% increase in risk of both all cancer incidence and mortality.[11] Meta-analysis in the current study suggests cancer-survivors that report the highest levels of post-diagnosis sedentary behaviour have a 22% increase in all-cause mortality risk as well as a 53% increase in CRC specific mortality risk. These results suggest that, even after cancer diagnosis and treatment, sedentary behaviour may contribute to poorer survival.

Overall, the evidence to date does not support a relationship between sedentary behaviour and patient reported outcomes including QOL, depression, anxiety, or pain, and showed inconsistent associations with fatigue. In general populations, increased sedentary behaviour has been associated with both depressive and pain symptoms.[50, 51] Studies identified improvements in QOL when replacing sedentary time with either light or MVPA, despite not identifying any associations between total sedentary time and QOL in single effects models.[40] This suggests that physical activity (of any intensity) may be required to improve QOL.

Importantly, many of the survivors in these studies had a high quality of life, low fatigue, and little to no depressive symptoms. As such, they may not represent the most vulnerable survivors.

The available evidence did not support an association between sedentary behaviour and either BMI or WC in cancer survivors. While the number of studies was low, and only one study to date has been longitudinal, this finding is consistent with a previous review that could not provide sufficient evidence for a longitudinal relationship between sedentary behaviour and weight or increases in waist circumference in general populations.[52] However, there was some evidence of anthropometric change, with one study documenting a prospective decrease in lean mass percentage in more sedentary survivors.[46]

This review incorporated all cancer types, and while an association between sedentary behaviour and CRC specific mortality was identified, the number of studies addressing other types of cancer prevented further investigation via either meta-analysis or systematic synthesis. The accumulation of a broader body of research relating to sedentary behaviour and other site-specific mortality is warranted.

As previously acknowledged, there was heterogeneity in exposure assessment within this review. Given that self-reported estimates in physical activity and sedentary behaviour are subject to both random and systematic error,[53] using devices to measure sedentary behaviour has been proposed to be a key tool in obtaining more accurate effect estimates.[53, 54] However, only two of the 29 studies included in this review used a thigh-worn accelerometer, which are considered the most accurate methods of measurement of sedentary behaviour.[55] In contrast, hip worn accelerometers are subject to misclassification.[55] The results of studies which used accelerometers to measure sedentary behaviour were similar to those which used self-

reported measures. Whether this is due to an absence of independent associations or limitations in current methods of objective assessment cannot be determined.

The quality of the evidence for each outcome was scored from very low to low. Generally, the quality of evidence available for mortality outcomes was higher than that available for patient reported or anthropometric outcomes. Aside from objective and blinded assessment of outcomes, which are not possible for patient reported outcomes, mortality outcome evidence was rated higher as investigations were exclusively prospective, the key confounding factors were accounted for and appropriately measured in most studies, and there was greater consistency across findings. An absence of an independent association between sedentary behaviour and patient reported or anthropometric outcomes should not be taken as a definitive conclusion. For all outcomes, the availability of new intervention and prospective cohort studies will improve the overall confidence in effect estimates available.

Several limitations of this review should be considered when considering the findings. First, while a meta-analysis examining the interaction between post-diagnosis sedentary behaviour and both all-cause and CRC-specific mortality provides new information in this field, the likelihood of reverse causation in the primary studies must be acknowledged. That is, individuals with more severe cancer or treatment histories may be more likely to spend a greater proportion of their time sedentary. However, in individual studies, sensitivity analysis performed by removing individuals who reported sedentary time close to mortality did not change the statistical findings.[18-20, 23-25] In addition, to rate the quality of evidence, this review employed GRADE. While the GRADE system provides a structured process for rating a collection of evidence[56] and is therefore a strength, it was primarily developed to address questions regarding alternative management strategies or interventions, and does not score evidence regarding risk, prognosis, or association highly.[15] Finally, although this review did

not employ date or language restrictions to the search strategy, it is possible that relevant studies were not identified in the systematic search employed.

Conclusion

Associations between post-diagnosis sedentary behaviour and all-cause as well as CRC-specific mortality in cancer survivors were demonstrated by meta-analyses. However, associations between sedentary behaviour and either patient reported or anthropometric outcomes were less clear in these populations. Given the relatively small number of studies available, as well as their methodological limitations, these conclusions may not be definitive.

References

1. Jensen RE, Potosky AL, Moinpour CM, et al. United States population-based estimates of patient-reported outcomes measurement information system symptom and functional status reference values for individuals with cancer. J Clin Oncol 2017;35(17): 1913-20.

2. Sedentary Behaviour Research Network. Letter to the editor: standardized use of the terms "sedentary" and "sedentary behaviours". Appl Physiol Nutr Metab 2012;37(3): 540-2.

3. Tremblay MS, Aubert S, Barnes JD, et al. Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. International Journal of Behavioral Nutrition and Physical Activity 2017;14(1): 75.

4. Lynch BM, Dunstan DW, Vallance JK, Owen N. Don't take cancer sitting down: a new survivorship research agenda. Cancer 2013;119(11): 1928-35.

5. Dunstan DW, Barr EL, Healy GN, et al. Television viewing time and mortality: the Australian Diabetes, Obesity and Lifestyle Study (AusDiab). Circulation 2010;121(3): 384-91.

6. Ekelund U, Brage S, Froberg K, et al. TV viewing and physical activity are independently associated with metabolic risk in children: the European Youth Heart Study. PLoS medicine 2006;3(12): e488-e88.

7. Patterson R, McNamara E, Tainio M, et al. Sedentary behaviour and risk of all-cause, cardiovascular and cancer mortality, and incident type 2 diabetes: a systematic review and dose response meta-analysis. Eur J Epidemiol 2018;33(9): 811-29.

8. Hamilton MT. The role of skeletal muscle contractile duration throughout the whole day: reducing sedentary time and promoting universal physical activity in all people. J Physiol 2018;596(8): 1331-40.

9. Katzmarzyk PT, Powell KE, Jakicic JM, Troiano RP, Piercy K, Tennant B. Sedentary behavior and health: Update from the 2018 Physical Activity Guidelines Advisory Committee. Med Sci Sports Exerc 2019;51(6): 1227-41.

10. Schmid D, Leitzmann MF. Television viewing and time spent sedentary in relation to cancer risk: a meta-analysis. J Natl Cancer Inst 2014;106(7).

11. Biswas A, Oh PI, Faulkner GE, et al. Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. Ann Intern Med 2015;162(2): 123-32.

12. Kerr J, Anderson C, Lippman SM. Physical activity, sedentary behaviour, diet, and cancer: an update and emerging new evidence. Lancet Oncol 2017;18(8): e457-e71.

13. Moher D, Liberati A, Tetzlaff J, Altman DG, Group atP. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA StatementThe PRISMA Statement. Ann Intern Med 2009;151(4): 264-69.

14. Centre for Research Synthesis and Decision Analysis, University of Bristol. The ROBINS-E tool. Available from URL: https://www.bristol.ac.uk/population-health-sciences/centres/cresyda/barr/riskofbias/robins-e/ [accessed 01/03, 2019].

15. Guyatt G, Oxman AD, Akl EA, et al. GRADE guidelines: 1. Introduction - GRADE evidence profiles and summary of findings tables. J Clin Epidemiol 2011;64(4): 383-94.

16. Ogilvie D, Fayter D, Petticrew M, et al. The harvest plot: A method for synthesising evidence about the differential effects of interventions. BMC Med Res Methodol 2008;8(1): 8.

17. Arem H, Pfeiffer RM, Moore SC, Brinton LA, Matthews CE. Body mass index, physical activity, and television time in relation to mortality risk among endometrial cancer survivors in the NIH-AARP Diet and Health Study cohort. Cancer Causes Control 2016;27(11): 1403-09.

18. Arem H, Pfeiffer RM, Engels EA, et al. Pre- and postdiagnosis physical activity, television viewing, and mortality among patients with colorectal cancer in the National Institutes of Health-AARP Diet and Health Study. J Clin Oncol 2015;33(2): 180-8.

19. Campbell PT, Patel AV, Newton CC, Jacobs EJ, Gapstur SM. Associations of recreational physical activity and leisure time spent sitting with colorectal cancer survival. J Clin Oncol 2013;31(7): 876-85.

20. Cao Y, Meyerhardt JA, Chan AT, Wu K, Fuchs CS, Giovannucci EL. Television watching and colorectal cancer survival in men. Cancer Causes Control 2015;26(10): 1467-76.

21. Friedenreich CM, Wang Q, Neilson HK, Kopciuk KA, McGregor SE, Courneya KS. Physical Activity and Survival After Prostate Cancer. Eur Urol 2016;70(4): 576-85.

22. George SM, Smith AW, Alfano CM, et al. The association between television watching time and all-cause mortality after breast cancer. J Cancer Surviv 2013;7(2): 247-52.

23. Ratjen I, Schafmayer C, di Giuseppe R, et al. Postdiagnostic physical activity, sleep duration, and TV watching and all-cause mortality among long-term colorectal cancer survivors: a prospective cohort study. BMC Cancer 2017;17(1): 701.

24. Schmid D, Behrens G, Arem H, et al. Pre- and post-diagnosis physical activity, television viewing, and mortality among hematologic cancer survivors. PLoS One 2018;13(1): e0192078.

25. Schmid D, Matthews CE, Leitzmann MF. Physical activity and sedentary behavior in relation to mortality among renal cell cancer survivors. PLoS ONE 2018;13(6).

26. D'Silva A, Gardiner PA, Boyle T, Bebb DG, Johnson ST, Vallance JK. Associations of objectively assessed physical activity and sedentary time with health-related quality of life among lung cancer survivors: A quantile regression approach. Lung Cancer 2018;119: 78-84.

27. Forsythe LP, Alfano CM, George SM, et al. Pain in long-term breast cancer survivors: The role of body mass index, physical activity, and sedentary behavior. Breast Cancer Research and Treatment 2013;137(2): 617-30.

28. Gaskin CJ, Craike M, Mohebbi M, et al. Associations of objectively measured moderate-to-vigorous physical activity and sedentary behavior with quality of life and psychological well-being in prostate cancer survivors. Cancer Causes Control 2016;27(9): 1093-103.

29. George SM, Alfano CM, Groves J, et al. Objectively measured sedentary time is related to quality of life among cancer survivors. PLoS ONE 2014;9(2).

30. George SM, Alfano CM, Smith AW, et al. Sedentary behavior, health-related quality of life, and fatigue among breast cancer survivors. J Phys Act Health 2013;10(3): 350-58.

31. Hartman SJ, Marinac CR, Bellettiere J, et al. Objectively measured sedentary behavior and quality of life among survivors of early stage breast cancer. Support Care Cancer 2017;25(8): 2495-503.

32. Lynch BM, Cerin E, Owen N, Hawkes AL, Aitken JF. Television viewing time of colorectal cancer survivors is associated prospectively with quality of life. Cancer Causes Control 2011;22(8): 1111-20.

33. Phillips SM, Awick EA, Conroy DE, Pellegrini CA, Mailey EL, McAuley E. Objectively measured physical activity and sedentary behavior and quality of life indicators in survivors of breast cancer. Cancer 2015;121(22): 4044-52.

34. Phillips SM, Stampfer MJ, Chan JM, Giovannucci EL, Kenfield SA. Physical activity, sedentary behavior, and health-related quality of life in prostate cancer survivors in the health professionals follow-up study. J Cancer Surviv 2015;9(3): 500-11.

35. Rogers LQ, Markwell SJ, Courneya KS, McAuley E, Verhulst S. Physical activity type and intensity among rural breast cancer survivors: Patterns and associations with fatigue and depressive symptoms. J Cancer Surviv 2011;5(1): 54-61.

36. Sabiston CM, Lacombe J, Faulkner G, Jones J, Trinh L. Profiling sedentary behavior in breast cancer survivors: Links with depression symptoms during the early survivorship period. Psycho-Oncology 2018;27(2): 569-75.

37. Trinh L, Amireault S, Lacombe J, Sabiston CM. Physical and psychological health among breast cancer survivors: Interactions with sedentary behavior and physical activity. Psycho-Oncology 2015;24(10): 1279-85.

38. Trinh L, Plotnikoff RC, Rhodes RE, North S, Courneya KS. Associations between sitting time and quality of life in a population-based sample of kidney cancer survivors. Ment Health Phys Act 2013;6(1): 16-23.

39. Vallance JK, Bebb GD, Boyle T, Johnson ST, Gardiner PA, D'Silva A. Psychosocial health is associated with objectively assessed sedentary time and light intensity physical activity among lung cancer survivors. Ment Health Phys Act 2018;14: 61-65.

40. Vallance JK, Buman MP, Lynch BM, Boyle T. Reallocating time to sleep, sedentary, and active behaviours in non-Hodgkin lymphoma survivors: associations with patient-reported outcomes. Ann Hematol 2017;96(5): 749-55.

41. Vallance JK, Boyle T, Courneya KS, Lynch BM. Accelerometer-assessed physical activity and sedentary time among colon cancer survivors: associations with psychological health outcomes. J Cancer Surviv 2015;9(3): 404-11.

42. Vallance JK, Boyle T, Courneya KS, Lynch BM. Associations of objectively assessed physical activity and sedentary time with health-related quality of life among colon cancer survivors. Cancer 2014;120(18): 2919-26.

43. Van Roekel E, Bours M, Breedveld-Peters J, et al. Modeling how substitution of sedentary behavior with standing or physical activity is associated with health-related quality of life in colorectal cancer survivors. Cancer Causes Control 2016;27(4): 513-25.

44. Van Roekel EH, Winkler EAH, Bours MJL, et al. Associations of sedentary time and patterns of sedentary time accumulation with health-related quality of life in colorectal cancer survivors. Prev Med Rep 2016;4: 262-69.

45. Boyle T, Vallance JK, Buman MP, Lynch BM. Reallocating time to sleep, sedentary time, or physical activity: Associations with waist circumference and body mass index in breast cancer survivors. Cancer Epidemiol Biomarkers Prev 2017;26(2): 254-60.

46. Howell CR, Wilson CL, Ehrhardt MJ, et al. Clinical impact of sedentary behaviors in adult survivors of acute lymphoblastic leukemia: A report from the St. Jude Lifetime Cohort study. Cancer 2018;124(5): 1036-43.

47. Lynch BM, Dunstan DW, Winkler E, Healy GN, Eakin E, Owen N. Objectively assessed physical activity, sedentary time and waist circumference among prostate cancer survivors: Findings from the National Health and Nutrition Examination Survey (2003-2006). Eur J Cancer Care 2011;20(4): 514-19.

48. Lynch BM, Dunstan DW, Healy GN, Winkler E, Eakin E, Owen N. Objectively measured physical activity and sedentary time of breast cancer survivors, and associations with adiposity: Findings from NHANES (2003-2006). Cancer Causes Control 2010;21(2): 283-88.

49. Wijndaele K, Lynch BM, Owen N, Dunstan DW, Sharp S, Aitken JF. Television viewing time and weight gain in colorectal cancer survivors: a prospective population-based study. Cancer Causes Control 2009;20(8): 1355-62.

50. Teychenne M, Ball K, Salmon J. Sedentary behavior and depression among adults: a review. Int J Behav Med 2010;17(4): 246-54.

51. Heneweer H, Vanhees L, Picavet HSJ. Physical activity and low back pain: A U-shaped relation? PAIN 2009;143(1): 21-25.

52. Proper KI, Singh AS, van Mechelen W, Chinapaw MJ. Sedentary behaviors and health outcomes among adults: a systematic review of prospective studies. Am J Prev Med 2011;40(2): 174-82.

53. Matthews CE, Moore SC, George SM, Sampson J, Bowles HR. Improving self-reports of active and sedentary behaviors in large epidemiologic studies. Exerc Sport Sci Rev 2012;40(3): 118-26.

54. Lynch BM, Owen N. Too much sitting and chronic disease risk: Steps to move the science forward. Ann Intern Med 2015;162(2): 146-47.

55. Berendsen BA, Hendriks MR, Meijer K, Plasqui G, Schaper NC, Savelberg HH. Which activity monitor to use? Validity, reproducibility and user friendliness of three activity monitors. BMC Public Health 2014;14(1): 749.

56. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ 2008;336(7650): 924-26.

Table 1: Quality of evidence: Post diagnosis sedentary behaviour in cancer survivors

Outcomes	No of participants (study type)	Meta-analysis effect estimates (95% CI)	Quality of evidence
All-cause mortality	16,073 (9 prospective)	1.22 (1.06, 1.41)†	Low
CRC specific mortality	6,791 (3 prospective)	1.53 (1.14, 2.06) †	Low
Quality of life	3,034 (3 prospective) 1,425 (8 cross-sectional)	NA	Very low §
Fatigue	1,068 (2 prospective) 1,889 (8 cross-sectional)	NA	Very low §
Depression	545 (2 prospective) 1,571 (6 cross-sectional)	NA	Very low §
Anxiety	358 (1 prospective) 548 (4 cross-sectional)	NA	Very low §
Pain	1,232 (2 prospective) 351 (3 cross-sectional)	NA	Very low §
BMI	1,818 (2 prospective) 367 (2 cross-sectional)	NA	Very low §
WC	330 (1 prospective) 469 (3 cross-sectional)	NA	Very low §

Key: CRC = colorectal cancer; QOL = quality of life; BMI = Body mass index; WC = waist circumference; †HR (95% CI); ‡ SMD (95% CI); § rated down due to serious risk of bias

Figure legends:

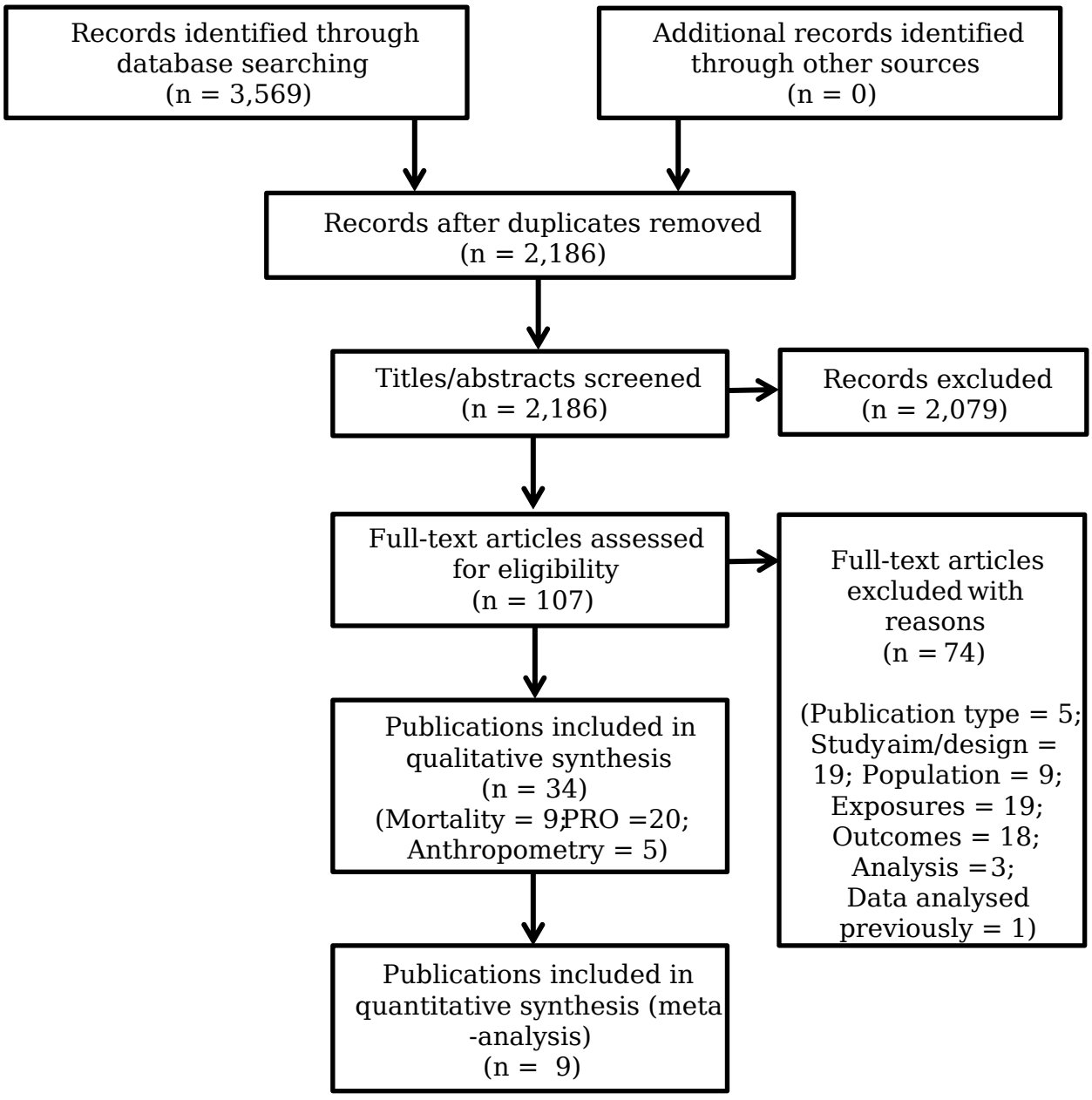
Figure 1: PRISMA flow diagram

Figure 2: Meta-analysis of hazard ratios for sedentary behaviour and a) all-cause mortality as well as b) colorectal cancer specific mortality in cancer survivors. CI, confidence interval.

Figure 3: Harvest plots for health-related quality of life, specific cancer concerns, body mass index (BMI) and waist circumference (WC). Tall bars represent prospective cohort studies, and short bars represent cross-sectional studies. Each study reference number is provided on top of each bar. Inside each bar we provide regression coefficients (β), mean (M), least square means (LSM), or mean difference (MD) values and 95% confidence intervals (CIs) where reported—when 95% CIs were not available we provided p-values. Mean values are expressed as minutes of SB, where a unit is not indicated. All associations represented are between the lowest and highest categories of sedentary behaviour. We chose the associations from the model that adjusted for most covariates in each study. Key: EORTC QLQ-C30 GH=European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core-30 Global Health; FACT-B=Functional Assessment of Cancer Therapy Questionnaire-Breast; FACT-C=FACT-Colorectal; FACT-G=FACT-General; SF-36 GH=Short-Form 36 General Health; NA=not applicable; p tr=p trend; ALL=acute lymphoblastic leukaemia; NHL=non-Hodgkin Lymphoma; CRC=colorectal cancer; KSI=Kidney Symptom Index. *Sample consisted of colon cancer patients only.

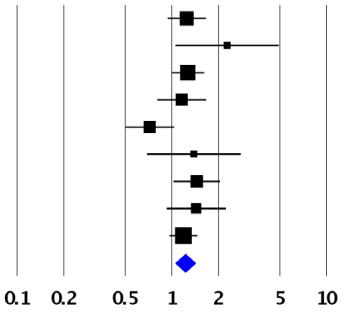
Figure 4: Harvest plots for QOL domains including physical function, mental health, and social and functional wellbeing. Tall bars represent prospective cohort studies, and short bars represent cross-sectional studies. Each study reference number is provided on top of each bar. Inside each bar we provide regression coefficients (β), mean (M), least square means (LSM), or mean difference (MD) values and 95% confidence intervals (CIs) where reported—when 95% CIs were not available we provided p-values. Mean values are expressed as minutes of SB, where a unit is not indicated. All associations represented are between the lowest and highest categories of sedentary behaviour. We chose the associations from the model that adjusted for most covariates in each study. Key: NA=not applicable; EORTC QLQ-C30 PF=European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core-30 Physical function; FACT-PWB=Functional Assessment of Cancer Therapy Questionnaire Physical Wellbeing; SF-36 PF SS=Short-Form 36 Physical Function Summary Score; p tr = p trend; EORTC QLQ-C30 EF=EORTC QLQ-C30 Emotional Function; FACT-EWB=FACT-Emotional Wellbeing; SF-36 MH SS=SF-36 Mental Health Summary Score; HADS=Hospital Anxiety and Depression Scale; EORTC QLQ-C30 SF=EORTC QLQ-C30= Social Functioning; FACT-SWB=FACT-Social Wellbeing; SF-36 SF=SF-36 Social Function; EORTC QLQ-C30 RF=EORTC QLQ-C30 Role Function; FACT-FWB=FACT-Functional Wellbeing; SF-36 P-RF=SF-36 Physical-Role Function. *This study assessed distress (anxiety and depression combined) and not general mental health.

Figure 5: Harvest plot for depression, anxiety, and pain. Tall bars represent prospective cohort studies, and short bars represent cross-sectional studies. Study reference numbers are provided on top of each bar. Inside each bar we provide regression coefficients (β), mean (M), least square means (LSM), or mean difference (MD) values and 95% confidence intervals (CIs) where reported—when 95% CIs were not available we provided p-values. Mean values are expressed as minutes of SB, where a unit is not indicated. All associations represented are between the lowest and highest categories of sedentary behaviour. We chose the associations from the model that adjusted for most covariates in each study. Key: CIS=Checklist Individual Strength; EORTC QLQ-C30 FSS=European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core-30 Fatigue Subscale; FACT-FS=Functional Assessment of Cancer Therapy Questionnaire Fatigue Scale; FSI=Fatigue Symptom Inventory; PFS F-BS=Piper Fatigue Scale Fatigue-Behaviour Severity; POMS=Profile of Mood States; p tr=p trend; NA=not applicable; NHL=non-Hodgkin Lymphoma; CES-D=Centre for Epidemiologic Studies Depression Scale; HADS=Hospital Anxiety and Depression Scale; PHQ-9=Patient Health Questionnaire; MAX-PC=Memorial Anxiety Scale for Prostate Cancer; STAI=State-Trait Anxiety Inventory; PRIME MD=Primary Care Evaluation of Mental Disorders; SF-36 BP=Short-Form-36 Bodily Pain; WHODASII=World Health Organization Disability Assessment Schedule II; and. *Sample consisted of colon cancer patients only; **This study assessed disability and not pain.


Records identified through database searching (n = 3,569)
Additional records identified through other sources (n = 0)
Records after duplicates removed (n = 2,186)
Titles/abstracts screened (n = 2,186)
Records excluded (n = 2,079)
Full-text articles assessed for eligibility (n = 107)
Full-text articles excluded with reasons (n = 74)
(Publication type = 5; Study aim/design = 19; Population = 9; Exposures = 19; Outcomes = 18; Analysis = 3; Data analysed previously = 1)
Publications included in qualitative synthesis (n = 34)
(Mortality = 9; PRO = 20; Anthropometry = 5)
Publications included in quantitative synthesis (meta-analysis) (n = 9)

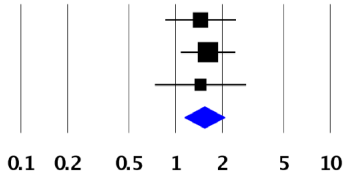
a)

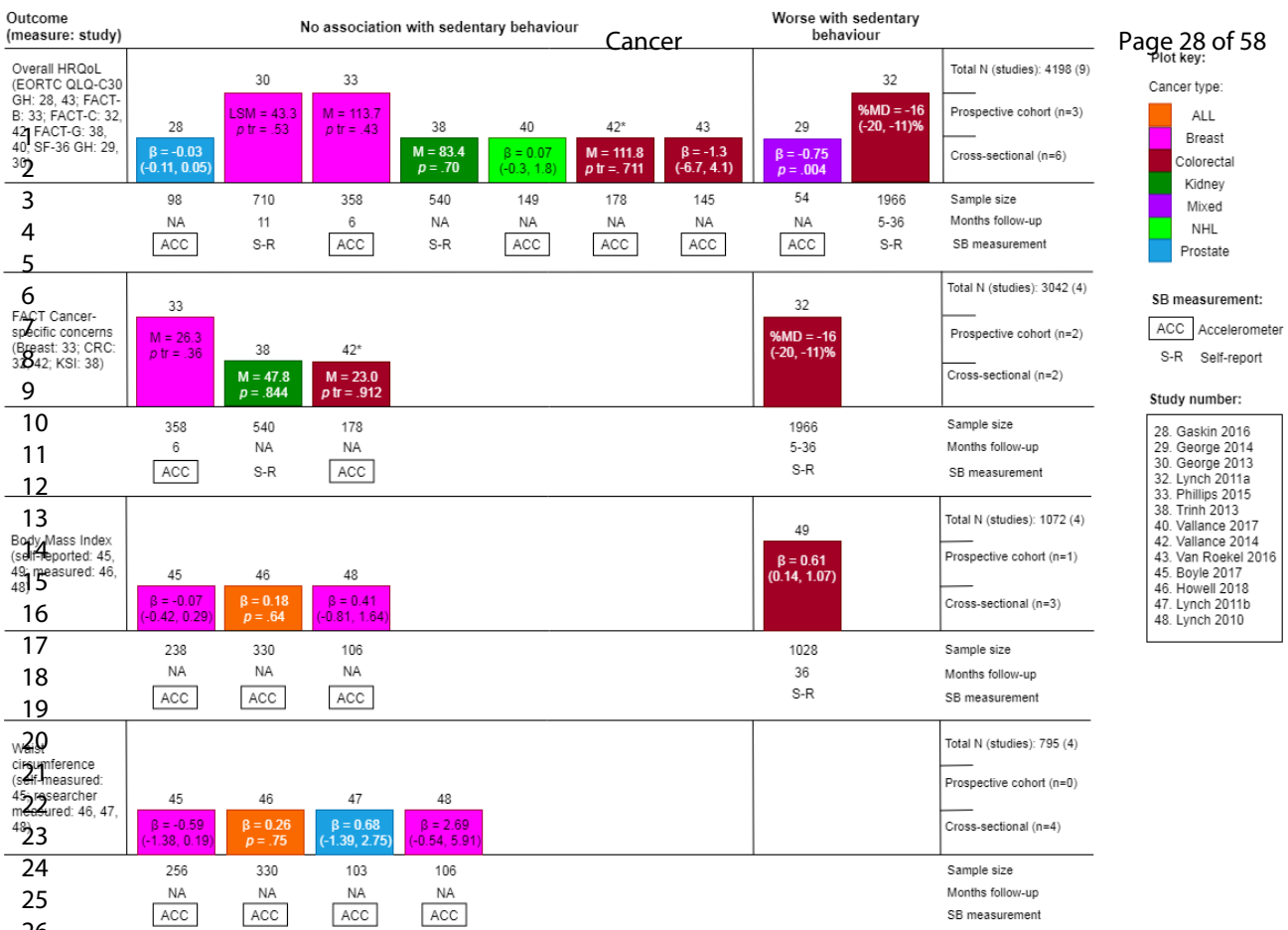
	Hazard ratio	Lower limit	Upper limit	Z-Value	p-Value
Arem et al, 2015	1.250	0.933	1.675	1.494	0.135
Arem et al, 2016	2.280	1.050	4.950	2.084	0.037
Campbell et al, 2013	1.270	0.987	1.635	1.856	0.063
Cao et al, 2015	1.160	0.800	1.681	0.784	0.433
Friedenreich et al, 2016	0.720	0.497	1.043	-1.736	0.083
George et al, 2013	1.390	0.688	2.810	0.917	0.359
Ratjen et al, 2017	1.450	1.020	2.061	2.072	0.038
Schmid et al, 2018a	1.440	0.921	2.252	1.598	0.110
Schmid et al, 2018b	1.190	0.962	1.473	1.600	0.110
	1.222	1.056	1.414	2.698	0.007

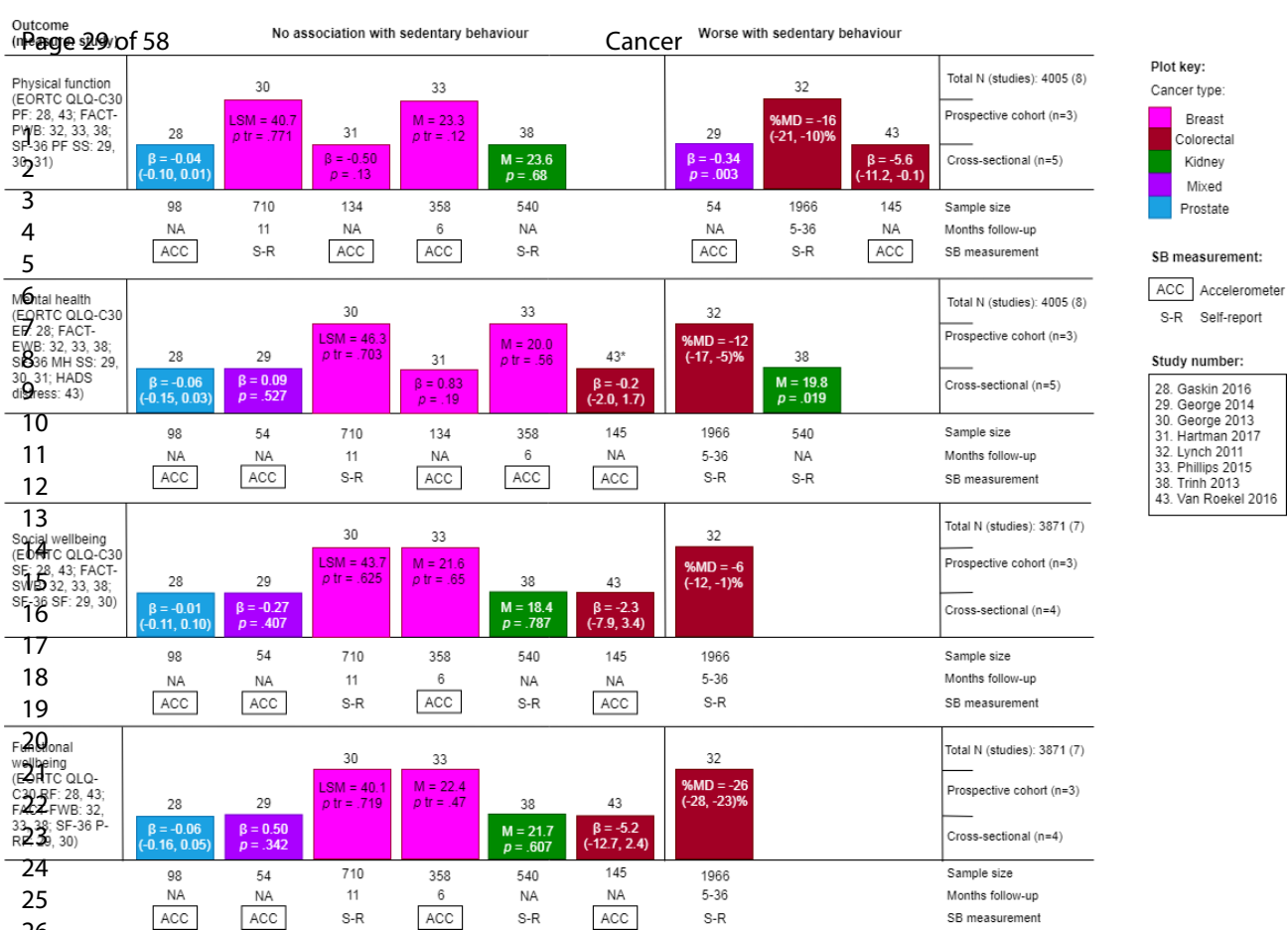


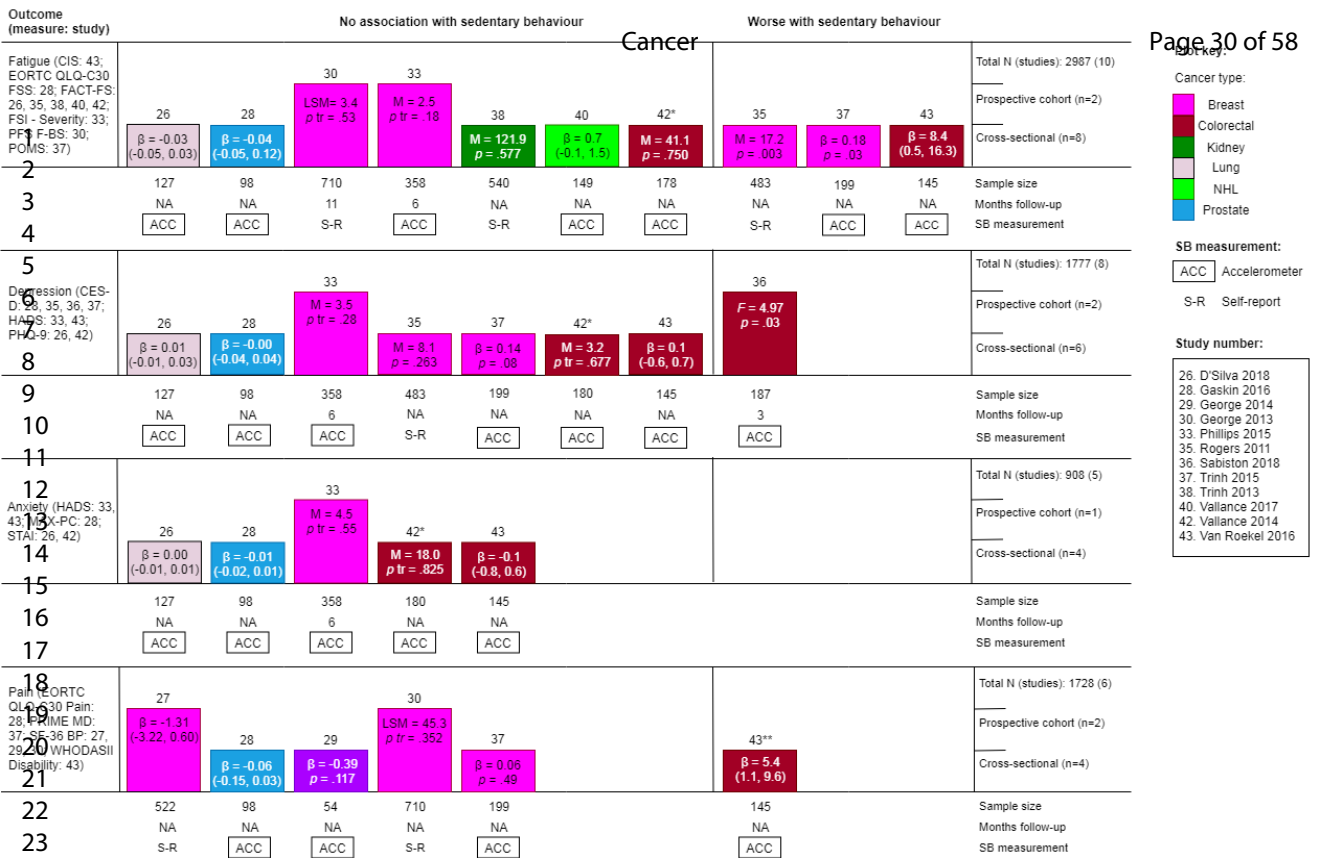
b)

	Hazard ratio	Lower limit	Upper limit	Z-Value	p-Value
Arem et al, 2015	1.450	0.851	2.472	1.365	0.172
Campbell et al, 2013	1.620	1.073	2.446	2.294	0.022
Cao et al, 2015	1.450	0.731	2.875	1.064	0.287
	1.534	1.143	2.060	2.850	0.004




Cancer
Outcome (measure: study)
No association with sedentary behaviour
Worse with sedentary behaviour
Overall HRQoL (EORTC QLQ-C30 GH: 28, 43; FACT-B: 33; FACT-C: 32, 42; FACT-G: 38, 40; SF-36 GH: 29, 30)
28 β = -0.03 (-0.11, 0.05)
30 LSM = 43.3 p tr = .53
33 M = 113.7 p tr = .43
38 M = 83.4 p = .70
40 β = 0.07 (-0.3, 1.8)
42* M = 111.8 p tr = .711
43 β = -1.3 (-6.7, 4.1)
29 β = -0.75 p = .004
32 %MD = -16 (-20, -11)%
Total N (studies): 4198 (9)
Prospective cohort (n=3)
Cross-sectional (n=6)
98 NA ACC
710 11 S-R
358 6 ACC
540 NA S-R
149 NA ACC
178 NA ACC
145 NA ACC
54 NA ACC
1966 5-36 S-R
Sample size
Months follow-up
SB measurement
FACT Cancer-specific concerns (Breast: 33; CRC: 32, 42; KSI: 38)
33 M = 26.3 p tr = .36
38 M = 47.8 p = .844
42* M = 23.0 p tr = .912
32 %MD = -16 (-20, -11)%
Total N (studies): 3042 (4)
Prospective cohort (n=2)
Cross-sectional (n=2)
358 6 ACC
540 NA S-R
178 NA ACC
1966 5-36 S-R
Sample size
Months follow-up
SB measurement
Body Mass Index (self-reported: 45, 49; measured: 46, 48)
45 β = -0.07 (-0.42, 0.29)
46 β = 0.18 p = .64
48 β = 0.41 (-0.81, 1.64)
49 β = 0.61 (0.14, 1.07)
Total N (studies): 1072 (4)
Prospective cohort (n=1)
Cross-sectional (n=3)
238 NA ACC
330 NA ACC
106 NA ACC
1028 36 S-R
Sample size
Months follow-up
SB measurement
Waist circumference (self-measured: 45; researcher measured: 46, 47, 48)
45 β = -0.59 (-1.38, 0.19)
46 β = 0.26 p = .75
47 β = 0.68 (-1.39, 2.75)
48 β = 2.69 (-0.54, 5.91)
Total N (studies): 795 (4)
Prospective cohort (n=0)
Cross-sectional (n=4)
256 NA ACC
330 NA ACC
103 NA ACC
106 NA ACC
Sample size
Months follow-up
SB measurement
Plot key:
Cancer type:
ALL
Breast
Colorectal
Kidney
Mixed
NHL
Prostate
SB measurement:
ACC Accelerometer
S-R Self-report
Study number:
28. Gaskin 2016
29. George 2014
30. George 2013
32. Lynch 2011a
33. Phillips 2015
38. Trinh 2013
40. Vallance 2017
42. Vallance 2014
43. Van Roekel 2016
45. Boyle 2017
46. Howell 2018
47. Lynch 2011b
48. Lynch 2010


Outcome (Number of studies)
No association with sedentary behaviour
Cancer
Worse with sedentary behaviour
Physical function (EORTC QLQ-C30 PF: 28, 43; FACT-PWB: 32, 33, 38; SF-36 PF SS: 29, 30, 31)
28
β = -0.04 (-0.10, 0.01)
30
LSM = 40.7 p tr = .771
31
β = -0.50 p = .13
33
M = 23.3 p tr = .12
38
M = 23.6 p = .68
29
β = -0.34 p = .003
32
%MD = -16 (-21, -10)%
43
β = -5.6 (-11.2, -0.1)
Total N (studies): 4005 (8)
Prospective cohort (n=3)
Cross-sectional (n=5)
98 710 134 358 540 54 1966 145
Sample size
NA 11 NA 6 NA NA 5-36 NA
Months follow-up
ACC S-R ACC ACC S-R ACC S-R ACC
SB measurement
Mental health (EORTC QLQ-C30 EF: 28; FACT-EWB: 32, 33, 38; SF-36 MH SS: 29, 30, 31; HADS distress: 43)
28
β = -0.06 (-0.15, 0.03)
29
β = 0.09 p = .527
30
LSM = 46.3 p tr = .703
31
β = 0.83 p = .19
33
M = 20.0 p tr = .56
43*
β = -0.2 (-2.0, 1.7)
32
%MD = -12 (-17, -5)%
38
M = 19.8 p = .019
Total N (studies): 4005 (8)
Prospective cohort (n=3)
Cross-sectional (n=5)
98 54 710 134 358 145 1966 540
Sample size
NA NA 11 NA 6 NA 5-36 NA
Months follow-up
ACC ACC S-R ACC ACC ACC S-R S-R
SB measurement
Social wellbeing (EORTC QLQ-C30 SF: 28, 43; FACT-SWB: 32, 33, 38; SF-36 SF: 29, 30)
28
β = -0.01 (-0.11, 0.10)
29
β = -0.27 p = .407
30
LSM = 43.7 p tr = .625
33
M = 21.6 p tr = .65
38
M = 18.4 p = .787
43
β = -2.3 (-7.9, 3.4)
32
%MD = -6 (-12, -1)%
Total N (studies): 3871 (7)
Prospective cohort (n=3)
Cross-sectional (n=4)
98 54 710 358 540 145 1966
Sample size
NA NA 11 6 NA NA 5-36
Months follow-up
ACC ACC S-R ACC S-R ACC S-R
SB measurement
Functional wellbeing (EORTC QLQ-C30 RF: 28, 43; FACT-FWB: 32, 33, 38; SF-36 P-RP: 29, 30)
28
β = -0.06 (-0.16, 0.05)
29
β = 0.50 p = .342
30
LSM = 40.1 p tr = .719
33
M = 22.4 p tr = .47
38
M = 21.7 p = .607
43
β = -5.2 (-12.7, 2.4)
32
%MD = -26 (-28, -23)%
Total N (studies): 3871 (7)
Prospective cohort (n=3)
Cross-sectional (n=4)
98 54 710 358 540 145 1966
Sample size
NA NA 11 6 NA NA 5-36
Months follow-up
ACC ACC S-R ACC S-R ACC S-R
SB measurement
Plot key:
Cancer type:
Breast
Colorectal
Kidney
Mixed
Prostate
SB measurement:
ACC Accelerometer
S-R Self-report
Study number:
28. Gaskin 2016
29. George 2014
30. George 2013
31. Hartman 2017
32. Lynch 2011
33. Phillips 2015
38. Trinh 2013
43. Van Roekel 2016


Outcome (measure: study)
No association with sedentary behaviour
Worse with sedentary behaviour
Fatigue (CIS: 43; EORTC QLQ-C30 FSS: 28; FACT-FS: 26, 35, 38, 40, 42; FSI - Severity: 33; PFS F-BS: 30; POMS: 37)
26 β = -0.03 (-0.05, 0.03)
28 β = -0.04 (-0.05, 0.12)
30 LSM= 3.4 p tr = .53
33 M = 2.5 p tr = .18
38 M = 121.9 p = .577
40 β = 0.7 (-0.1, 1.5)
42* M = 41.1 p = .750
35 M = 17.2 p = .003
37 β = 0.18 p = .03
43 β = 8.4 (0.5, 16.3)
Total N (studies): 2987 (10)
Prospective cohort (n=2)
Cross-sectional (n=8)
127 NA ACC
98 NA ACC
710 11 S-R
358 6 ACC
540 NA S-R
149 NA ACC
178 NA ACC
483 NA S-R
199 NA ACC
145 NA ACC
Sample size
Months follow-up
SB measurement
Depression (CES-D: 28, 35, 36, 37; HADS: 33, 43; PHQ-9: 26, 42)
26 β = 0.01 (-0.01, 0.03)
28 β = -0.00 (-0.04, 0.04)
33 M = 3.5 p tr = .28
35 M = 8.1 p = .263
37 β = 0.14 p = .08
42* M = 3.2 p tr = .677
43 β = 0.1 (-0.6, 0.7)
36 F = 4.97 p = .03
Total N (studies): 1777 (8)
Prospective cohort (n=2)
Cross-sectional (n=6)
127 NA ACC
98 NA ACC
358 6 ACC
483 NA S-R
199 NA ACC
180 NA ACC
145 NA ACC
187 3 ACC
Sample size
Months follow-up
SB measurement
Anxiety (HADS: 33, 43; MFI-PC: 28; STAI: 26, 42)
26 β = 0.00 (-0.01, 0.01)
28 β = -0.01 (-0.02, 0.01)
33 M = 4.5 p tr = .55
42* M = 18.0 p tr = .825
43 β = -0.1 (-0.8, 0.6)
Total N (studies): 908 (5)
Prospective cohort (n=1)
Cross-sectional (n=4)
127 NA ACC
98 NA ACC
358 6 ACC
180 NA ACC
145 NA ACC
Sample size
Months follow-up
SB measurement
Pain (EORTC QLQ-C30 Pain: 28; PRIME MD: 37; SF-36 BP: 27, 29; WHODASII Disability: 43)
27 β = -1.31 (-3.22, 0.60)
28 β = -0.06 (-0.15, 0.03)
29 β = -0.39 p = .117
30 LSM = 45.3 p tr = .352
37 β = 0.06 p = .49
43** β = 5.4 (1.1, 9.6)
Total N (studies): 1728 (6)
Prospective cohort (n=2)
Cross-sectional (n=4)
522 NA S-R
98 NA ACC
54 NA ACC
710 NA S-R
199 NA ACC
145 NA ACC
Sample size
Months follow-up
SB measurement
Plot key:
Cancer type:
Breast
Colorectal
Kidney
Lung
NHL
Prostate
SB measurement:
ACC Accelerometer
S-R Self-report
Study number:
26. D'Silva 2018
28. Gaskin 2016
29. George 2014
30. George 2013
33. Phillips 2015
35. Rogers 2011
36. Sabiston 2018
37. Trinh 2015
38. Trinh 2013
40. Vallance 2017
42. Vallance 2014
43. Van Roekel 2016

MEDLINE (OVID). 14.6.19

1	'Sedentary behavior' [MeSH] OR 'sitting position' [MESH] OR 'sedentary behaviour' OR 'sedentary behavior' OR 'sedentary time' OR sitting OR 'television viewing' OR 'television time' OR 'television watching' OR 'TV viewing' OR 'TV time' OR 'TV viewing' OR 'screen time' OR 'computer use'	33679
2	Neoplasms [MESH] OR cancer OR carcinoma OR tumour OR tumor OR lymphoma OR leukaemia OR leukemia	2862830
3	1 AND 2	1267

Free text search limited to title (ti), abstract (ab), and key heading word (kf)

Sport Discus 14.6.19

1	'sedentary behaviour' OR 'sedentary behavior' OR 'sedentary time' OR sitting OR 'television viewing' OR 'television time' OR 'television watching' OR 'TV viewing' OR 'TV time' OR 'TV viewing' OR 'screen time' OR 'computer use'	6961
2	Cancer OR carcinoma OR tumour OR tumor OR lymphoma OR leukaemia OR leukemia	25266
3	1 AND 2	110

Free text search limited to title (ti), abstract (ab), and key word (kw)

Embase 14.6.19

1	'sedentary time' [PT] OR 'screen time' [PT] OR 'sedentary behaviour' OR 'sedentary behavior' OR 'sedentary time' OR sitting OR 'television viewing' OR 'television time' OR 'television watching' OR 'TV viewing' OR 'TV time' OR 'TV viewing' OR 'screen time' OR 'computer use'	40800
2	'neoplasm' [PT] OR Cancer OR carcinoma OR tumour OR tumor OR lymphoma OR leukaemia OR leukemia	4018958
3	1 AND 2	1753

Free text search limited to title (ti), abstract (ab), and author key word (kw)

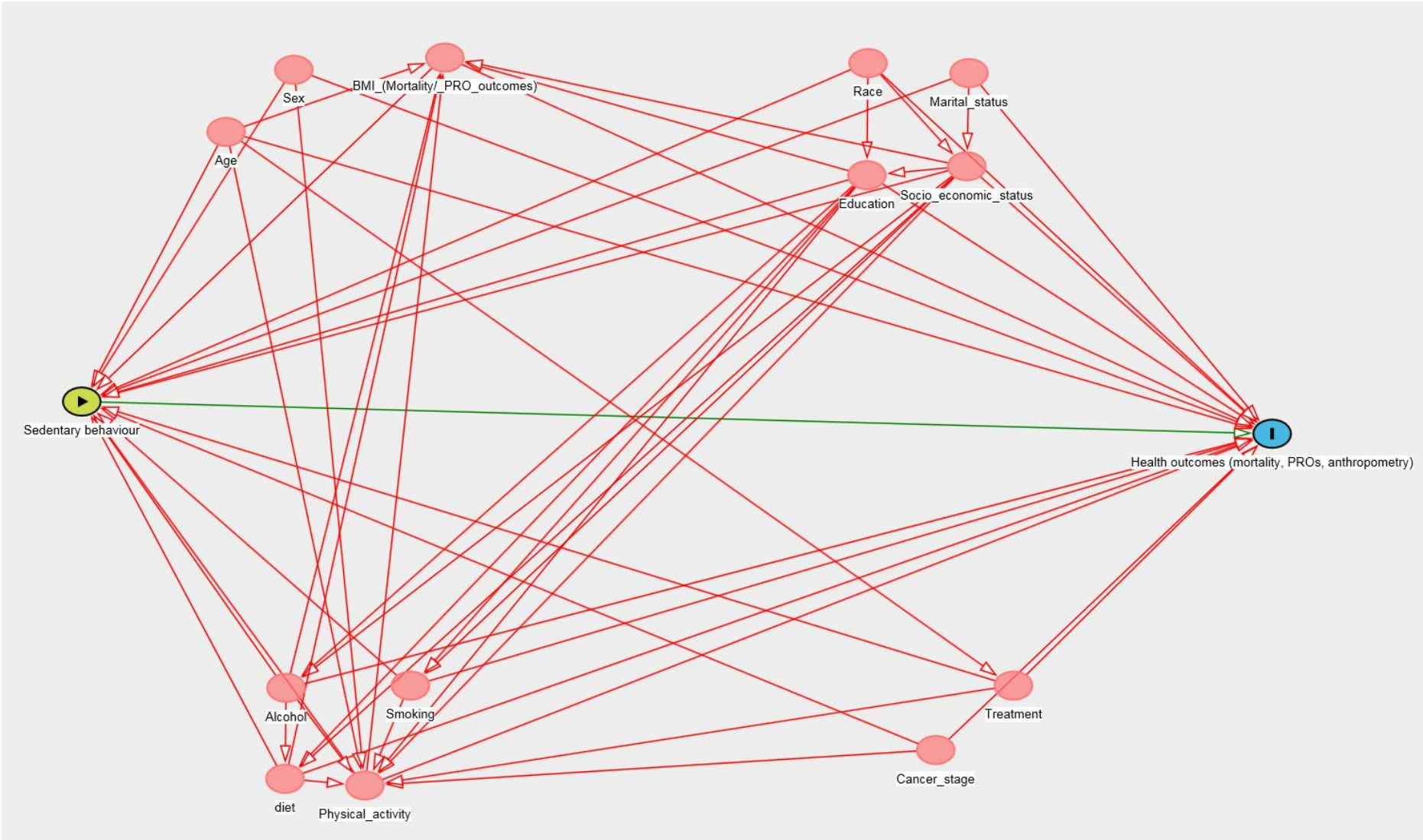
CINAHL 14.6.19

1	'sedentary behaviour' OR 'sedentary behavior' OR 'sedentary time' OR sitting OR 'television viewing' OR 'television time' OR 'television watching' OR 'TV viewing' OR 'TV time' OR 'TV viewing' OR 'screen time' OR 'computer use'	13227
2	'neoplasm' [MESH] OR Cancer OR carcinoma OR tumour OR tumor OR lymphoma OR leukaemia OR leukemia	606885
3	1 AND 2	439

Free text search limited to title (ti), abstract (ab), and word in subject heading (mw)

CITATIONS IDENTIFIED VIA FWD CITATION SEARCH: NIL

CTITATIONS IDENTIFIED VIA SEARCHING REFERENCE LISTS OF INCLUDED PAPER AND OTHER REVIEWS: NIL


Sex
BMI_(Mortality/_PRO_outcomes)
Race
Marital_status
Age
Education
Socio_economic_status
Sedentary behaviour
Health outcomes (mortality, PROs, anthropometry)
Alcohol
Smoking
Treatment
Cancer_stage
diet
Physical_activity

AUTHOR	TITLE	JOURNAL	YEAR	FIRST REASON FOR EXCLUSION
Badr, Hoda, Chandra, Joya, Paxton, Raheem J., Ater, Joann L., Urbauer, Diana, Cruz, Cody Scott and Demark-Wahnefried, Wendy	Health-related quality of life, lifestyle behaviors, and intervention preferences of survivors of childhood cancer	Journal of Cancer Survivorship	2013	POPULATION
Boing, Leonessa, da Cruz Ramos de Araujo, Camila, Soares Pereira, Gustavo, Moratelli, Jéssica, Benneti, Magnus, Ferreti Borgatto, Adriano, Bergmann, Anke and de Azevedo Guimarães, Adriana Coutinho	TEMPO SENTADO, IMAGEM CORPORAL E QUALIDADE DE VIDA EM MULHERES APÓS A CIRURGIA DO CÂNCER DE MAMA. / SITTING TIME, BODY IMAGE AND QUALITY OF LIFE IN WOMEN AFTER BREAST CANCER SURGERY	Revista Brasileira de Medicina do Esporte	2017	STUDY DESIGN
Boisen, S., Krageloh, C., Shepherd, D., Ryan, C., Masters, J., Osborne, S., MacLeod, R. D., Gray, M. and Keogh, J. W.	A Cross-Sectional Comparison of Quality of Life Between Physically Active and Underactive Older Men With Prostate Cancer	J Aging Phys Act	2016	EXPOSURE
Bourke, L., Gilbert, S., Hooper, R., Steed, L. A., Joshi, M., Catto, J. W., Saxton, J. M. and Rosario, D. J.	Lifestyle changes for improving disease-specific quality of life in sedentary men on long-term androgen-deprivation therapy for advanced prostate cancer: a randomised controlled trial	European Urology	2014	POPULATION
Boyle, T., Lynch, B. M., Ransom, E. K. and Vallance, J. K.	Volume and correlates of objectively measured physical activity and sedentary time in non-Hodgkin lymphoma survivors	Psycho-Oncology	2017	STUDY DESIGN
Boyle, Terry, Vallance, Jeff, Ransom, Emily, Lynch, Brigid, Vallance, Jeff K., Ransom, Emily K. and Lynch, Brigid M.	How sedentary and physically active are breast cancer survivors, and which population subgroups have higher or lower levels of these behaviors?	Supportive Care in Cancer	2016	STUDY DESIGN
Brenner, D. R., Neilson, H. K., Courneya, K. S. and Friedenreich, C. M.	Physical activity after breast cancer: Effect on survival and patient-	Current Breast Cancer Reports	2014	PUBLICATION TYPE

	reported outcomes			
Broderick, J. M., Hussey, J., Kennedy, M. J. and O'Donnell, D. M.	Testing the 'teachable moment' premise: Does physical activity increase in the early survivorship phase?	Supportive Care in Cancer	2014	STUDY DESIGN
Canario, A. C., Cabral, P. U., de Paiva, L. C., Florencio, G. L., Spyrides, M. H. and Goncalves, A. K.	Physical activity, fatigue and quality of life in breast cancer patients	Rev Assoc Med Bras (1992)	2016	EXPOSURE
Carpentier, M. Y., Mullins, L. L., Elkin, T. D. and Wolfe-Christensen, C.	Prevalence of multiple health-related behaviors in adolescents with cancer	Journal of Pediatric Hematology/Oncology	2008	POPULATION
Carter, S. J., Hunter, G. R., Norian, L. A., Turan, B. and Rogers, L. Q.	Ease of walking associates with greater free-living physical activity and reduced depressive symptomology in breast cancer survivors: pilot randomized trial	Supportive Care in Cancer	2018	POPULATION
Collins, R. H. and McGowan, E. L.	Exploring associations of sedentary behavior and physical activity with quality of life in young adult cancer survivors	Journal of Adolescent and Young Adult Oncology	2018	ANALYSIS
Conejo, I., Pajares, B., Alba, E. and Cuesta-Vargas, A. I.	Grado de acuerdo entre la acelerometría y el Cuestionario Internacional de Actividad Física en pacientes supervivientes de cáncer de mama	Fisioterapia	2018	STUDY DESIGN
Doryab, Afsaneh, Ferreira, Denzil, Sun, Weijing, Low, Carissa A., Kamarck, Thomas, Dey, Anind K. and Bae, Sangwon	Estimation of Symptom Severity During Chemotherapy From Passively Sensed Data: Exploratory Study	Journal of Medical Internet Research	2017	EXPOSURE
D'Silva, A., Bebb, G., Boyle, T., Johnson, S. T. and Vallance, J. K.	Demographic and clinical correlates of accelerometer assessed physical activity and sedentary time in lung cancer survivors	Psycho-Oncology	2018	STUDY DESIGN

D'Silva, Adrijana, Bebb, Gwyn, Boyle, Terry, Johnson, Steve and Vallance, Jeff	P1.01-044 Accelerometer-Determined Physical Activity and Sedentary Time among Lung Cancer Survivors: Topic: Prognostic Factors, Treatment	Journal of Thoracic Oncology	2017	PUBLICATION TYPE
Dsouza, A., Kamboj, R., Mandavkar, S., Chavan, N., Ramaswamy, A. and Ostwal, V.	An evaluation of early-onset fatigue and the related coping strategies in patients with gastrointestinal cancer: A prospective pilot study	Indian Journal of Cancer	2018	EXPOSURE
Ehlers, D. K., Fanning, J., Salerno, E. A., Aguiñaga, S., Cosman, J., Severson, J., Kramer, A. F. and McAuley, E.	Replacing sedentary time with physical activity or sleep: Effects on cancer-related cognitive impairment in breast cancer survivors	BMC Cancer	2018	OUTCOME
Fassier, P., Zelek, L., Partula, V., Srour, B., Bachmann, P., Touillaud, M., Druesne-Pecollo, N., Galan, P., Cohen, P., Hoarau, H., Latino-Martel, P., Menai, M., Oppert, J. M., Hercberg, S., Deschasaux, M. and Touvier, M.	Variations of physical activity and sedentary behavior between before and after cancer diagnosis: Results from the prospective population-based NutriNet-Santé cohort	Medicine (United States)	2016	STUDY DESIGN
Ferriolli, E., Skipworth, R. J., Hendry, P., Scott, A., Stensteth, J., Dahele, M., Wall, L., Greig, C., Fallon, M., Strasser, F., Preston, T. and Fearon, K. C.	Physical activity monitoring: a responsive and meaningful patient-centered outcome for surgery, chemotherapy, or radiotherapy?	Journal of Pain & Symptom Management	2012	EXPOSURE
Forbes, C. C., Keats, M., Rainham, D., Younis, T. and Blanchard, C. M.	Changes in objectively measured activity behavior among women undergoing breast cancer treatment: Longitudinal cohort study	Rehabilitation Oncology	2018	OUTCOME
Foucaut, A. M., Berthouze, S. E., Touillaud, M., Morelle, M., Bourne-Branchu, V., Kempf-Lépine, A. S., Carretier, J., Pérol, D., Trédan, O., Bachmann, P. and Fervers, B.	Deterioration of physical activity level and metabolic risk factors after early-stage breast cancer diagnosis	Cancer Nursing	2015	STUDY DESIGN
Hacker, E. D., Kim, I., Park, C. and Peters, T.	Real-time Fatigue and Free-Living	Cancer Nursing	2017	EXPOSURE

	Physical Activity in Hematopoietic Stem Cell Transplantation Cancer Survivors and Healthy Controls: A Preliminary Examination of the Temporal, Dynamic Relationship			
Harrison, Sheree A., Hayes, Sandra C. and Newman, Beth	Age-Related Differences in Exercise and Quality of Life among Breast Cancer Survivors	Medicine & Science in Sports & Exercise	2010	EXPOSURE
Hartman, S. J., Marinac, C. R., Cadmus-Bertram, L., Kerr, J., Natarajan, L., Godbole, S., Patterson, R. E., Morey, B. and Sears, D. D.	Sedentary Behaviors and Biomarkers Among Breast Cancer Survivors	Journal of Physical Activity & Health	2018	OUTCOME
Hartman, S. J., Nelson, S. H., Myers, E., Natarajan, L., Sears, D. D., Palmer, B. W., Weiner, L. S., Parker, B. A. and Patterson, R. E.	Randomized controlled trial of increasing physical activity on objectively measured and self-reported cognitive functioning among breast cancer survivors: The memory & motion study	Cancer	2018	EXPOSURE
Hawkes, A. L., Gollschewski, S., Lynch, B. M. and Chambers, S.	A telephone-delivered lifestyle intervention for colorectal cancer survivors 'CanChange': A pilot study	Psycho-Oncology	2009	EXPOSURE
Hawkes, A. L., Lynch, B. M., Owen, N. and Aitken, J. F.	Lifestyle factors associated concurrently and prospectively with co-morbid cardiovascular disease in a population-based cohort of colorectal cancer survivors	European Journal of Cancer	2011	OUTCOMES
Jeffery, E., Lee, Y. C. G., McVeigh, J., Straker, L., Wooding, T., Newton, R. U. and Peddle-McIntyre, C.	Feasibility of objectively measured physical activity and sedentary behavior in patients with malignant pleural effusion	Supportive Care in Cancer	2017	OUTCOMES
Keefe, F. J., Brantley, A., Manuel, G. and Crisson, J. E.	Behavioral assessment of head and neck cancer pain	Pain	1985	OUTCOMES
Kim, R. B., Phillips, A., Herrick, K., Helou, M.,	Physical Activity and Sedentary	PLoS ONE [Electronic	2013	OUTCOMES

Rafie, C., Anscher, M. S., Mikkelsen, R. B. and Ning, Y.	Behavior of Cancer Survivors and Non-Cancer Individuals: Results from a National Survey	Resource]		
Kindred, M. M., Pinto, B. M. and Dunsiger, S. I.	Predictors of sedentary behavior among colorectal survivors	Supportive Care in Cancer	2018	STUDY DESIGN
Koutoukidis, Dimitrios A., Lopes, Sonia, Atkins, Lou, Croker, Helen, Knobf, M. Tish, Lanceley, Anne and Beeken, Rebecca J.	Use of intervention mapping to adapt a health behavior change intervention for endometrial cancer survivors: the shape-up following cancer treatment program	BMC Public Health	2018	PUBLICATION TYPE
Kwan, M. L., Sternfeld, B., Ergas, I. J., Timperi, A. W., Roh, J. M., Hong, C. C., Quesenberry, C. P. and Kushi, L. H.	Change in physical activity during active treatment in a prospective study of breast cancer survivors	Breast Cancer Research and Treatment	2012	OUTCOME
LaCroix, Andrea Z., Rillamas-Sun, Eileen, Buchner, David, Evenson, Kelly R., Chongzhi, Di, Lee, I. Min, Marshall, Steve, LaMonte, Michael J., Hunt, Julie, Tinker, Lesley Fels, Stefanick, Marcia, Lewis, Cora E., Bellettiere, John, Herring, Amy H., Di, Chongzhi and Lee, I. Min	The Objective Physical Activity and Cardiovascular Disease Health in Older Women (OPACH) Study	BMC Public Health	2017	POPULATION
Lawrence, Logan, Stone, Michelle, Rainham, Daniel and Keats, Melanie	Environments Associated with Moderate-to-Vigorous Physical Activity and Sedentary Behavior of Colorectal Cancer Survivors	International Journal of Behavioral Medicine	2017	OUTCOMES
Lowe, S. S., Danielson, B., Beaumont, C., Watanabe, S. M., Baracos, V. E. and Courneya, K. S.	Associations between objectively measured physical activity and quality of life in cancer patients with brain metastases	Journal of Pain and Symptom Management	2014	EXPOSURE
Lowe, S. S., Danielson, B., Beaumont, C., Watanabe, S. M., Baracos, V. E. and Courneya, K. S.	Correlates of objectively measured sedentary behavior in cancer patients with brain metastases: An application of the theory of planned behavior	Psycho-Oncology	2015	EXPOSURE

Lynch, B. M., Courneya, K. S., Sethi, P., Patrao, T. A. and Hawkes, A. L.	A randomized controlled trial of a multiple health behavior change intervention delivered to colorectal cancer survivors: Effects on sedentary behavior	Cancer	2014	STUDY DESIGN
Lynch, Brigid, Boyle, Terry, Winkler, Elisabeth, Occleston, Jessica, Courneya, Kerry, Vallance, Jeff, Lynch, Brigid M., Courneya, Kerry S. and Vallance, Jeff K.	Erratum to: Patterns and correlates of accelerometer-assessed physical activity and sedentary time among colon cancer survivors	Cancer Causes & Control	2016	PUBLICATION TYPE
Lynch, Brigid, Boyle, Terry, Winkler, Elisabeth, Occleston, Jessica, Courneya, Kerry, Vallance, Jeff, Lynch, Brigid M., Courneya, Kerry S. and Vallance, Jeff K.	Patterns and correlates of accelerometer-assessed physical activity and sedentary time among colon cancer survivors	Cancer Causes & Control	2016	STUDY DESIGN
Lynch, Brigid, Mihala, Gabor, Beesley, Vanessa, Wiseman, Allan, Gordon, Louisa, Lynch, Brigid M., Beesley, Vanessa L., Wiseman, Allan J. and Gordon, Louisa G.	Associations of health behaviours with return to work outcomes after colorectal cancer	Supportive Care in Cancer	2016	OUTCOMES
Mama, S. K., Song, J., Ortiz, A., Tirado-Gomez, M., Palacios, C., Hughes, D. C. and Basen-Engquist, K.	Longitudinal social cognitive influences on physical activity and sedentary time in Hispanic breast cancer survivors	Psycho-Oncology	2017	POPULATION
Marinac, C. R., Nelson, S. H., Cadmus-Bertram, L., Kerr, J., Natarajan, L., Godbole, S. and Hartman, S. J.	Dimensions of sedentary behavior and objective cognitive functioning in breast cancer survivors	Supportive Care in Cancer	2018	OUTCOMES
Mascherini, G., Tosi, B., Giannelli, C., Grifoni, E., Degl'innocenti, S. and Galanti, G.	Breast cancer: effectiveness of a one-year unsupervised exercise program	The Journal of sports medicine and physical fitness	2019	EXPOSURE
Murphy-Alford, A. J., White, M., Lockwood, L., Hallahan, A. and Davies, P. S. W.	Body composition, dietary intake and physical activity of young survivors of childhood cancer	Clin Nutr	2018	POPULATIONS
Nelson, S. H., Marinac, C. R., Patterson, R. E., Nechuta, S. J., Flatt, S. W., Caan, B. J., Kwan, M. L., Poole, E. M., Chen, W. Y., Shu, X. O.	Impact of very low physical activity, BMI, and comorbidities on mortality among breast cancer survivors	Breast Cancer Research and Treatment	2016	EXPOSURE

and Pierce, J. P.				
Ni, J., Feng, J., Denehy, L., Wu, Y., Xu, L. and Granger, C. L.	Symptoms of Posttraumatic Stress Disorder and Associated Risk Factors in Patients With Lung Cancer: A Longitudinal Observational Study	Integrative Cancer Therapies	2018	OUTCOME
Ortiz, A., Tirado, M., Hughes, D. C., Gonzalez, V., Song, J., Mama, S. K. and Basen-Engquist, K.	Relationship between physical activity, disability, and physical fitness profile in sedentary Latina breast cancer survivors	Physiother Theory Pract	2018	STUDY DESIGN
Paxton, R. J., Taylor, W. C., Chang, S., Courneya, K. S. and Jones, L. A.	Lifestyle Behaviors of African American Breast Cancer Survivors: A Sisters Network, Inc. Study	PLoS ONE [Electronic Resource]	2013	STUDY DESIGN
Paxton, Raheem J., Anderson, Alexandra, Sarkar, Sonali and Taylor, Wendell C.	Breaking Up Sedentary Behavior	Cancer Nursing	2016	OUTCOME
Peddle-Mcintyre, Carolyn J., Jeffery, Emily, Vallance, Jeff K., Cavalheri, Vinicius, Boyle, Terry, McVeigh, Joanne A. and Lynch, Brigid M.	A Review of Accelerometer-based Activity Monitoring in Cancer Survivorship Research	Medicine & Science in Sports & Exercise	2018	PUB TYPE
Phillips, S. M., Dodd, K. W., Steeves, J., McClain, J., Alfano, C. M. and McAuley, E.	Physical activity and sedentary behavior in breast cancer survivors: New insight into activity patterns and potential intervention targets	Gynecologic Oncology	2015	STUDY DESIGN
Phillips, S. M., Lloyd, G. R., Awick, E. A. and McAuley, E.	Correlates of objectively measured sedentary behavior in breast cancer survivors	Cancer Causes and Control	2016	SD
Plotnikoff, R. C., Costigan, S. A., Short, C., Grunseit, A., James, E., Johnson, N., Bauman, A., D'Este, C., Van Der Ploeg, H. P. and Rhodes, R. E.	Factors associated with higher sitting time in general, chronic disease, and psychologically-distressed, adult populations: Findings from the 45 & up Study	PLoS ONE [Electronic Resource]	2015	SD
Ribeiro, F. E., Vanderlei, L. C. M., Palma, M. R., Tebar, W. R., Caldeira, D. T., Teles Fregonesi, C. E. P. and Christofaro, D. G. D.	Body dissatisfaction and its relationship with overweight, sedentary behavior and physical	European Journal of Obstetrics Gynecology and Reproductive	2018	OUTCOME

	activity in survivors of breast cancer	Biology		
Sabiston, C. M., Brunet, J., Vallance, J. K. and Meterissian, S.	Prospective examination of objectively assessed physical activity and sedentary time after breast cancer treatment: Sitting on the crest of the teachable moment	Cancer Epidemiology Biomarkers and Prevention	2014	STUDY DESIGN
Sanders, A. B., Conroy, D. E., Schmitz, K. H. and Gusani, N.	Physical Activity and Sedentary Behavior in Older Gastrointestinal Cancer Survivors: Need and Acceptability of Digital Health Interventions	Journal of Gastrointestinal Cancer	2018	OUTCOME
Sardo Molmenti, C. L., Hibler, E. A., Ashbeck, E. L., Thomson, C. A., Garcia, D. O., Roe, D., Harris, R. B., Lance, P., Cisneroz, M., Martinez, M. E., Thompson, P. A. and Jacobs, E. T.	Sedentary behavior is associated with colorectal adenoma recurrence in men	Cancer Causes and Control	2014	OUTCOME
Schmidt, M. E., Chang-Claude, J., Seibold, P., Vrieling, A., Heinz, J., Flesch-Janys, D. and Steindorf, K.	Determinants of long-term fatigue in breast cancer survivors: results of a prospective patient cohort study	Psycho-Oncology	2015	EXPOSYRE
Schofield, C., Newton, R. U., Cohen, P. A., Galvão, D. A., McVeigh, J. A., Hart, N. H., Mohan, G. R., Tan, J., Salfinger, S. G., Straker, L. M. and Peddle-McIntyre, C. J.	Activity Behaviors and Physiological Characteristics of Women With Advanced-Stage Ovarian Cancer: A Preliminary Cross-sectional Investigation	International Journal of Gynecological Cancer	2018	ANALYSIS
Schofield, C., Newton, R. U., Cohen, P. A., Galvão, D. A., McVeigh, J. A., Mohan, G. R., Tan, J., Salfinger, S. G., Straker, L. M. and Peddle-McIntyre, C. J.	Health-related quality of life and pelvic floor dysfunction in advanced-stage ovarian cancer survivors: associations with objective activity behaviors and physiological characteristics	Supportive Care in Cancer	2018	ANALYSIS
Shi, J. W., MacInnis, R. J., Boyle, T., Vallance, J. K., Winkler, E. A. H. and Lynch, B. M.	Physical Activity and Sedentary Behavior in Breast and Colon Cancer Survivors Relative to Adults Without	Mayo Clinic Proceedings	2017	OUTCOME

	Cancer			
Smits, A., Smits, E., Lopes, A., Das, N., Hughes, G., Talaat, A., Pollard, A., Bouwman, F., Massuger, L., Bekkers, R. and Galaal, K.	Body mass index, physical activity and quality of life of ovarian cancer survivors: Time to get moving?	Gynecologic Oncology	2015	EXPOSURE
Stephenson, L. E., Gwyn, D. G., Reimer, R. A. and Nicole, S. N.	Physical activity and diet behaviour in colorectal cancer patients receiving chemotherapy: Associations with quality of life	BMC Gastroenterology	2009	EXPOSURE
Timmerman, J. G. J., Dekker-van Weering, M. G. H. M., Wouters, M. W. J. M. M., Stuiver, M. M. M., de Kanter, W. W. and Vollenbroek-Hutten, M. M. R. M.	Physical behavior and associations with health outcomes in operable NSCLC patients: A prospective study	Lung Cancer	2018	EXPOSURE
Tonosaki, A. and Ishikawa, M.	Physical activity intensity and health status perception of breast cancer patients undergoing adjuvant chemotherapy	European Journal of Oncology Nursing	2014	EXPOSURE
Trinh, L., Arbour-Nicitopoulos, K. P., Sabiston, C. M., Berry, S. R., Loblaw, A., Alibhai, S. M. H., Jones, J. M. and Faulkner, G. E.	RiseTx: Testing the feasibility of a web application for reducing sedentary behavior among prostate cancer survivors receiving androgen deprivation therapy	International Journal of Behavioral Nutrition and Physical Activity	2018	STUDY DESIGN
Ukawa, S., Tamakoshi, A., Wakai, K. and Kurozawa, Y.	Associations of daily walking and television viewing time with liver cancer mortality: Findings from the Japan Collaborative Cohort Study	Cancer Causes and Control	2014	POPULATION
Vetter, R., Dosemeci, M., Blair, A., Wacholder, S., Unsal, M., Engin, K. and Fraumeni, J. F., Jr.	Occupational physical activity and colon cancer risk in Turkey	European Journal of Epidemiology	1992	OUTCOME
Welch, W. A., Ehlers, D., Gavin, K. L., Aguinaga, S., Cottrell, A., Nielsen, A., Solk, P., McAuley, E. and Phillips, S. M	Effects of reallocating sedentary time with physical activity on quality of life indicators in breast cancer survivors	Psycho-Oncology	2019	DATA NOT NEW

Wolvers, M. D. J., Bussmann, J. B. J., Bruggeman-Everts, F. Z., Boerema, S. T., van de Schoot, R. and Vollenbroek-Hutten, M. M. R.	Physical Behavior Profiles in Chronic Cancer-Related Fatigue	International Journal of Behavioral Medicine	2018	EXPOSURE
Wrosch, C. and Sabiston, C. M.	Goal adjustment, physical and sedentary activity, and well-being and health among breast cancer survivors	Psycho-Oncology	2013	STUDY DESIGN
Yu, T., Lu, Q., Ou, X., Cao, D. and Yu, Q.	Association of sedentary behavior with the expression levels of biomarkers in colorectal cancer: Clinical analysis of 228 patients	Tohoku Journal of Experimental Medicine	2014	POPULATION

Table: Risk of bias judgements with reasons

Study	1		2		3	4		5	6		7		ROB
Arem 2015	M		L	L		L	L		L		L		**M**
Arem 2016	M		L	M	Did report performing sensitivity analysis	L	M	Missing data for126/706. These participants were younger, completed less MVPA and had more TV viewing time	L		L		**S**
Campbell 2013	M		L	L		L	L		L		L		**M**
Cao 2015	M		L	L		L	M	Missing > 10% post diagnosis TV time	L		L		**M**
Friedenreich 2016	S	Key confounders missing (e.g. education/ or socioeconomic)	L	L		L	L		L		L		**S**
George 2013 (Mortality)	M		L	M	Did report performing sensitivity analysis	L	L		L		L		**S**
Ratjen 2017	M		L	L		L	M	Missing exposure data from individuals older at diagnosis and had more metastases	L		L		**M**
Schmid 2018 (Renal)	M		L	L		L	L		L		L		**M**
Schmid 2018 (hematologic)	M		L	L		L	M	Missing post diagnosis TV viewing data	L		L		**M**
D'Silva 2018	M		L	S	CS - exposure not recorded prior to outcome assessment	L	L		S	Self-reported, participants know exposure	L		**S**
Forsythe 2013	M		L	L		L	M	>10% participants lost to follow up. Those available for follow up were younger, more educated, and had less advanced cancer	S	Self-reported, participants know exposure	M	pain, above average pain, exposed, changed in exposed	**S**
Gaskin 2016	S	Sample size, participant self-reporting heights and weights	L	S	CS - exposure not recorded prior to outcome assessment	L	M	>10% had missing exposure data	S	Self-reported, participants know exposure	M	Several QOL subscales + anxiety and depression	**S**
George 2013 (QOL)	M		L	L		L	L		S	Self-reported, participants know exposure	M	Several subscales	**S**
George 2014	S	Key confounders missing (e.g.	L	S	CS - exposure not recorded prior to	L	M	Missing data for = 10% of participants	S	Self-reported, participants know exposure	M	Several subscales	**S**

		education/ or socioeconomic)			outcome assessment								
Hartman 2017	S	Key confounders missing (e.g. education, socioeconomic, partner status, diet)	L	S	CS - exposure not recorded prior to outcome assessment	L	M	>>10% of participants did not complete all relevant study assessments	S	Self-reported, participants know exposure	L		**S**
Lynch 2011 (QOL)	M		L	L		L	M	>10% of participants lost to follow up	S	Self-reported, participants know exposure	M	6 subscales, change in mood	**S**
Phillips 2015 (pca)	M		L	L		L	M	10% missing accel data, >10% missing outcomes/ confounder data	S	Self-reported, participants know exposure	M		**S**
Phillips 2015 (breast)	M		L	L		L	M	Missing exposure data >10%	S	Self-reported, participants know exposure	M	Several subscales, subgroup analysis	**S**
Rogers 2011	M		L	S	CS - exposure not recorded prior to outcome assessment	L	L		S	Self-reported, participants know exposure	L		**S**
Sabiston 2017	M		L	L		L	L		S	Self-reported, participants know exposure	L		**S**
Trinh 2013	M		L	S	CS - exposure not recorded prior to outcome assessment	L	L		S	Self-reported, participants know exposure	M	Several subscales, exposure measures	**S**
Trinh 2015	S	Key confounders missing (lifestyle socioeconomic anthropometric)	L	S	CS - exposure not recorded prior to outcome assessment	L	L		S	Self-reported, participants know exposure	M	Several subscales	**S**
Vallance 2014	M		L	S	CS - exposure not recorded prior to outcome assessment	L	L		S	Self-reported, participants know exposure	L		**S**
Vallance 2015	M		L	S	CS - exposure not recorded prior to outcome assessment	L	L		S	Self-reported, participants know exposure	L		**S**
Vallance 3	M		L	S	CS - exposure not recorded prior to outcome assessment	L	M	Missing outcome and exposure data for >10% of those that consented	S	Self-reported, participants know exposure	L		**S**
Vallance 4	M		L	S	CS - exposure not recorded prior to outcome assessment	L	L		S	Self-reported, participants know exposure	L		**S**
Van Roekel 2016	M		L	S	CS - exposure not recorded prior to outcome assessment	L	L		S	Self-reported, participants know exposure	L		**S**
Van Roekel 2016 (modelling)	M		L	S	CS - exposure not recorded prior to outcome assessment	L	L		S	Self-reported, participants know exposure	L		**S**
Boyle 2017	M		L	S	CS - exposure not recorded prior to	L	L		S	Self-reported, participants know	L		**S**

					outcome assessment					exposure, may be systematic errors in reporting BMI		
Howell 2018	M		L	L		L	L		L		L	**M**
Lynch 2010	S	Did not adjust for treatment confounders	L	S	CS - exposure not recorded prior to outcome assessment	L	M		L		L	**S**
Lynch 2011 (WC)	S	Did not adjust for treatment confounders	L	S	CS - exposure not recorded prior to outcome assessment	L	L		L		L	**S**
Wijndaele 2009	M		L	M	Self-report ST influenced by knowledge of outcome (obesity)	L	M	>10% lost to follow up/ withdrew at diff time points	S	Self-reported, participants know exposure, may be systematic errors in reporting BMI	L	**S**

Key: 1 = bias due to Confounding; 2 = Selection of participants; 3 = Exposure classification; 4 = Exposure departures; 5 = Missing data; 6 = Outcome assessment; 7 = Reporting of results; ROB = Overall risk of bias score; L = low; M = moderate; S = serious

Table 1. Study characteristics

Author, year, and country	Study design (follow-up duration); cohort; participant characteristics	Definition of sedentary behaviour; assessment method; criteria/categories	Primary outcome definition and assessment method	Confounding factors used for adjustment
Arem et al. 2016 USA	Prospective cohort study (7 y); NIH-AARP Diet and Health Study; 580 (F = 100%) endometrial cancer survivors; Mean (SD) age at diagnosis = 66.7 (1.3) y	TV viewing time: self-report questionnaire	Mortality (all cause): linkage to death registries	Age at diagnosis, tumor stage, tumor grade, first course of treatment, diabetes, age at menarche, hormone use at baseline, BMI, MVPA, self-reported health status
Arem et al. 2015 USA	Prospective cohort study (7 y); NIH-AARP Diet and Health Study; 3,784 (F = ~34%) colorectal cancer survivors in cohort (1,630 with post-diagnosis sedentary time data); Mean age at diagnosis = ~64 y	TV viewing time: self-report questionnaire	Mortality (all cause, CVD, cancer-specific): linkage to death registries	Age as underlying time metric, adjusted for sex, tumor site, tumor grade, tumor stage, surgery, radiation, chemotherapy, time reported in MVPA, and smoking status, BMI and self-reported health, pre and post diagnosis TV viewing time
Campbell et al. 2013 USA	Prospective cohort (6.8 y); Cancer Prevention Study-II Nutrition Cohort; 2,293 (F = 43%) colorectal cancer survivors; Mean age = NR	Leisure time spent sitting (including transport sitting, TV viewing and reading): self-report questionnaire Categorized in hours/day: <3, 3-6, >6	Mortality (all cause, colorectal cancer-specific, CVD deaths, all-other causes of death): linkage to death registries	Age, age at diagnosis, sex, smoking status, BMI, red meat intake, SEER summary stage at diagnosis, recreational PA, and education
Cao et al. 2015 USA	Prospective cohort (9.3 y, up to 25 y total); Health Professionals Follow-up Study; 714 (F = 0%) colorectal cancer survivors; Mean (SD) age at diagnosis = 70.3 (9.3) y	Total sitting time (TV watching, sitting at work, home, and while driving): self-report questionnaire	Mortality (all-cause, colorectal cancer-specific, other): family and postal authority report, as well as linkage to death registries	Age at diagnosis, years of diagnosis, stage of disease, grade of differentiation, tumor location, post diagnosis smoking status, post diagnosis PA, pre-diagnostic BMI, change in BMI and AHEI, pre-diagnostic TV watching
Friedenreich et al. 2016 Canada	Prospective cohort (14 y); 830 (F = 0%) stage II-IV prostate cancer patients; Median (IQR) age at diagnosis = 68 (11) y	Occupational sedentary behaviour: self-report questionnaire (LTPAQ)	Mortality (all-cause, prostate cancer-specific): linkage to death registries	Age at diagnosis, overall stage, treatment, Gleason score, PSA level, urban/rural, number of times had PSA test done, total pack-years of smoking at diagnosis, post diagnosis total pack-years of smoking, pre-

				diagnosis total physical activity, post diagnosis comorbidity, and time to any first recurrence/ progression of prostate cancer, and for non-sedentary behaviour.
George et al. 2013 USA	Prospective cohort (7 y); HEAL Study; 687 (F = 100%) breast cancer survivors; Mean (SE) age per category of sedentary time ranged from 56.1 (0.8) to 60.3 (0.8) y	TV viewing time: self-report questionnaire Categorized in hours: 0, <1, 1–2, 3–4, 5–6, 7–8, and ≥9	Mortality (all-cause): linkage to death registries	Age, MVPA, race, menopausal status, treatment, tamoxifen, number of activity-limiting comorbidities, and body mass index
Ratjen et al. 2017 Germany	Prospective Cohort (7 y); 1,376 (F = 44%) colorectal cancer survivors; Median age = 69 y	TV viewing time: self-report questionnaire	Mortality (all-cause): linkage to death registries	Age, sex, total physical activity, age at PA assessment, BMI, survival time until PA assessment, tumour location, occurrence of metastases, occurrence of other cancer, chemotherapy, smoking status, alcohol intake, (time x age), (time x BMI), (time x metastases)
Schmid et al. 2018 USA	Prospective cohort (7 y); NIH-AARP diet and Health Study; 627 (F = 27%) renal cancer survivors; Mean age per category of sedentary time from 70.9 to 71.8 y	TV viewing time: self-report questionnaire	Mortality (all-cause, renal cancer-specific): linkage to death registries	Age at exposure assessment, age at cancer diagnosis, sex, education, ethnicity, history of diabetes, history of hypertension, smoking at follow up, alcohol consumption, surgery, chemotherapy, radiation, stage, MVPA, BMI at follow up
Schmid et al. 2018 USA	Prospective cohort (~6 y); NIH-AARP diet and Health Study; 5,182 (F = 33%) hematologic cancer survivors in cohort and 1,636 with post-diagnosis sedentary time data available; Mean (SD) age at diagnosis = 71.6 (6.3) y	TV viewing time: self-report questionnaire	Mortality (all-cause, hematologic cancer-specific): linkage to death registries	Age at exposure assessment, age at cancer diagnosis, sex, education, race, smoking, alcohol consumption, chemotherapy, hematologic cancer subtype, stage (NHL survivors), physical activity, and BMI.

D'Silva et al. 2018 Vallance et al. 2018 Canada	Cross-sectional; Glans-Look Database Canada; 127 (F = NR) lung cancer survivors	Sedentary time: ActiGraph GT3X+ accelerometer, <100 counts per minute	HRQoL: FACT-Lung; Fatigue: 13-item FS Depressive symptoms: PHQ-9 State anxiety: STAI Psychological growth: PTGI Satisfaction with life: SWL	Accelerometer wear time, age, sex, smoking, BMI, comorbidity, months since diagnosis, stage, lung surgery, and MVPA
Forsythe et al. 2013 United States	Prospective cohort study (10 y); HEAL Study; 522 (F = 100%) breast cancer survivors (stages 0-IIIA); Mean age = 58.9 y	TV viewing time: self-report questionnaire	Pain: Body Pain subscale in SF-36	TV time and pain adjusted for smoking history, BMI, physical activity, time since diagnosis, and treatment history. Change in TV time and pain adjusted for race/ ethnicity, treatment history, smoking history, BMI, PA, and number of nodes examined.
Gaskin et al. 2016 Australia	Cross-sectional; ENGAGE study; 98 (F = 0%) prostate cancer survivors (stage I, II, or III) 3-12 months post-treatment completion; Mean (SD) age = 67.3 (8.0) y	Sedentary time: ActiGraph GT1 M, <100 counts/minute	HRQoL: EORTC QLQ-C30; Anxiety: MAX-PC Depressive symptoms: CES-D	Physical function adjusted for stage of disease; social function adjusted for clinician; fatigue adjusted for stage of disease and highest level of education; pain adjusted for number of comorbidities; total anxiety adjusted for age; depressive symptoms adjusted for clinician and highest level of education
George et al. 2013 United States	Prospective cohort (~11 month); HEAL study; 710 (F = 100%) breast cancer survivors; Mean (SE) age per quartile of sedentary time from 56.4 (0.7) to 59.2 (0.8) y	Time spent sitting: self-report questionnaire	HRQoL: SF-36; Fatigue: Piper Fatigue Scale	Age, treatment, post diagnosis recreational physical activity, diet quality, post diagnosis BMI, number of activity-limiting comorbidities, antidepressant use, race, and menopausal status
George et al. 2014 USA	Cross-sectional; Activity Trial for Improving Chemo-Brain; 54 (F = 83%) disease-free cancer survivors (breast, colorectal, haematological, head and neck, lung,	Sedentary time: Time spent sitting and lying via activPAL device	HRQoL: SF-36	Age, radiation treatment, h/day MVPA (activPAL), and cardiorespiratory fitness.

	and cervical cancer) who have completed ≥4 rounds of chemotherapy in the previous 5 years; Mean (SD) age = 54.3 (8.8) y			
Hartman et al. 2017 USA	Cross-sectional; Reach for Health Study; 134 (F = 100%) postmenopausal women with a breast cancer (stages I-III) diagnosis in past 5 years not currently undergoing chemotherapy; Mean (SD) age = 62.6 (6.6) y	Sedentary time: ActiGraph GT3X+ accelerometer, <100 counts/minute	HRQoL: SF-36	Continuous usage, BMI, cancer stage, accelerometer wear time, and time spent in total MVPA.
Lynch et al. 2011 Australia	Prospective cohort (5-36 months); Colorectal Cancer and Quality of Life Study; 1,966 (F = 40%) colorectal cancer survivors at baseline, 1,657 at 5-month follow-up, 1,474 at 24-month follow-up, and 1,266 at 36-month follow-up; Age ≥ 20 y	TV viewing time: self-report	HRQoL: FACT-C	Cancer site, stage, presence of stoma, comorbidities, type of treatment, gender, age, marital status, educational attainment, BMI, fatigue, nausea, problems with faecal control, smoking status, physical activity, and time
Phillips et al. 2015 USA	Prospective (2 y); Health Professionals Follow-Up Study; 1,917 (F = 100%) prostate cancer survivors; Mean (SD) age = ~75.2 (7.2) y	Sedentary behaviour (sitting at work, sitting while driving, TV viewing time, sitting while reading at home: sitting on a computer at home: other home sitting): self-report questionnaire	Cancer specific QoL: EPIC-26	Age at diagnosis; time since treatment; presence of comorbidities; stage of disease; Gleason score; treatment type; PSA at diagnosis; BMI, and pre-diagnosis sedentary time
Phillips et al. 2015 USA	Prospective (6 months); Army of Women of the Dr Susan Love Research Foundation; 358 (F = 100%) breast cancer survivors; Mean (SD) age = 56.4 (9.0) y	Sedentary time: ActiGraph GT1M, <100 counts/minute	HRQoL: FACT-B Anxiety and Depression: 14-item HADS; Fatigue: FSI	Age, time since diagnosis, treatment type, disease stage, education, and number of comorbidities, and MVPA
Rogers et al. 2011	Cross-sectional; 483 (F = 100%) breast cancer	Sitting time: IPAQ-LF	Fatigue: FACT-F; Depression: CES-D	Age, race, education, comorbidities, prior adjuvant treatment, months since diagnosis

USA	survivors; Mean (SD) age = 63 (12) y			and total PA min/week
Sabiston et al. 2017 Canada	Prospective (3 months); Life After Breast Cancer: Moving On; 187 (F = 100%) breast cancer survivors; Mean (SD) age = 55.0 (10.9) y	Sedentary behaviour: ActiGraph GT3X accelerometers, <100 counts/minute	Depression: CES-D	Age, education, lymph/axillary node dissection, being overweight, self-report, MVPA and objective MVPA, and baseline depression symptoms
Trinh et al. 2013 Canada	Cross-sectional; 540 (F = 37%) kidney cancer survivors; Mean (SD) age = 63.3 (10.7) y	Sitting time: Self-report (domain-specific sitting time questionnaire)	HRQoL: FACT-G; Fatigue: 13-item Fatigue Scale; Kidney cancer symptoms: FKSI-15	Age, sex, marital status, education, BMI, months since diagnosis, drug treatment, current treatment status, recurrence, current disease status, smoking, drinking, and number of comorbidities
Trinh et al. 2015 Canada	Cross-sectional; Life After Breast Cancer: Moving On; 199 (F = 100%) breast cancer survivors; Mean (SD) age = 55.0 (11.0) y	Sedentary time: ActiGraph GT3X accelerometer, <100 counts/minute	Pain symptoms: PRIME MD; Fatigue symptoms: POMS; Depression: CES-D	Months since diagnosis, menopausal status, WHR, disease stage, age, MVPA, and Leisure PA
Vallance et al. 2014 Vallance et al. 2015 Australia and Canada	Cross-sectional; 178 (F = 44%) colon cancer survivors; Mean (SD) age = 64.3 (10.3) y	Sedentary time: ActiGraph GT3X+ accelerometer, <100 counts/minute	HRQoL: FACT-C; TOI-C Fatigue: FACT-F Depression: PHQ-9 Anxiety: SAI Satisfaction with life: SWL	Sex, age, months since diagnosis, chemotherapy, comorbidity, stage, smoking, study site (Alberta/ Australia), and MVPA
Vallance et al. 2017 Australia	Cross-sectional; ACCEL-NHL study; 149 (F = 50%) non-Hodgkin lymphoma survivors; Median age = 64 y	Sedentary time: ActiGraph GT3X +, <100 counts/minute	HRQoL: FACT-G Fatigue: FS	Age, sex, area-level socioeconomic status and working status
Van Roekel, et al. 2016a Van Roekel et al. 2016b Netherlands	Cross-sectional; Energy for life after colorectal cancer study; 145 (F = 37%) colorectal cancer survivors; Mean (SD) age = 70.0 (8.7) y	Sitting/ lying during activities ≤1.5 METS during waking hours via triaxial MOX activity monitor	HRQoL: EORTC QLQ-C30; Disability: WHODAS2 Fatigue: 20-item Checklist Individual Strength; Anxiety and Depression: 14-item HADS	2016a: Age, gender, number of comorbidities, smoking status, time since diagnosis, cancer stage, BMI, perceived deficiency in social support score, chemotherapy received, stoma, tumour subsite, education level, having a partner 2016b: Waking wear time, age, gender,

				number of comorbidities, smoking status, time since diagnosis, cancer stage, BMI, paid employment, partner, stoma, tumor subsite, PA time
Boyle et al. 2017 Australia	Cross-sectional; ACCEL-Breast study; 256 (F = 100%) breast cancer survivors 2-4 y post diagnosis; Mean (SD) age = 60.1 (10.7) y	Sedentary time: ActiGraph GT3Xþ accelerometer, <100 counts/minute	Anthropometric: WC, BMI from self-reported height and weight	Single effects model adjusted for age, socioeconomic status, comorbidity, and smoking status
Howell et al. 2018 USA	Cross-sectional; St. Jude Lifetime Cohort; 330 (F = 48%) currently cancer free adult (≥18yrs) survivors (>10 y since diagnosis) of paediatric cancer; Mean (SD) age = 28.9 (6.1) y	Sedentary time: ActiGraph wGT3X-BT, <100 counts/minute Screen time: self-report; Categorized in hours/day: ≤2, 3-4, and ≥5	Anthropometric: BMI, WC, WHR, % LM (via DXA)	Sex, age at assessment, educational attainment, and cranial radiation exposure
Lynch et al. 2010 USA	Cross-sectional; NHANES; 111 (F = 100%) breast cancer survivors; Mean (SD) age = 69.2 (13.0) y	Sedentary time: ActiGraph 7164, <100 counts/minute	Anthropometric: WC, BMI	Age, ethnicity, total energy intake, log MVPA
Lynch et al. 2011 USA	Cross-sectional; NHANES; 103 (F = 0%) prostate cancer survivors; Mean (SD) age = 75.4 (7.3) y	Sedentary time: ActiGraph 7164, <100 counts/minute	Anthropometric: WC	Age, educational attainment, total energy intake, and MVPA
Wijndaele et al. 2009 Australia	Prospective cohort (36 months); 1,867 (F = 39%) colorectal cancer survivors at baseline, 1,488 at 24-month follow-up, and 1,261 at 36-month follow-up; Age ≥ 20 y	TV viewing time: self-report	Anthropometric: BMI from self-reported height and weight	Baseline BMI, gender, age, educational attainment, marital status, smoking, cancer site, cancer stage, mode of treatment, co-morbidities, and baseline PA

Key: y = years; NIH-AARP = National Institutes of Health-American Association of Retired Person; F = Female; SD = Standard Deviation; BMI = Body Mass Index; MVPA = Moderate-to-Vigorous Physical Activity; TV = Television; CVD = Cardiovascular Disease; NR = not reported; SEER = Surveillance, Epidemiology, and End Results; AHEI = Alternate Healthy Eating Index; IQR = Interquartile Range; LTPAQ = Lifetime Physical Activity Questionnaire; PSA = Prostate-specific Antigen; HEAL = Health, Eating, Activity, and Lifestyle; NHL = Non-Hodgkin lymphoma; FACT = Functional Assessment of Cancer Therapy; FS

= Fatigue Scale; ENGAGE = ; SF = Short Form; EORTC QLQ-C30 = European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire; MAX-PC = Memorial Anxiety Scale for Prostate Cancer; CES-D = Center for Epidemiologic Studies Depression Scale; FACT-C = Functional Assessment of Cancer Therapy-Colorectal; EPIC-26 = Expanded Prostate Cancer Index Composite-26; FACT-B = Functional Assessment of Cancer Therapy-Breast; FACT-F = Functional Assessment of Cancer Therapy-Fatigue; HADS = Hospital Anxiety and Depression Scale; FSI = Fatigue Symptom Inventory; FACT-G = Functional Assessment of Cancer Therapy-General; FKSI = Functional Assessment of Cancer Therapy-Kidney Symptom Index; PRIME MD = Primary care Evaluation of Mental Disorders; POMS = Profile of Mood States; WHR = Waist-to-Hip Ratio; PHQ-9 = Patient Health Questionnaire; STAI = State-Trait Anxiety Inventory; PTGI = Post-traumatic Growth Inventory; SWL = Satisfaction With Life; ACCEL-NHL = Accurate Measurement of Physical Activity and Sedentary time in non-Hodgkin Lymphoma; WHODAS v2 = World Health Organization's Disability Assessment Scale version 2; WC = Waist Circumference; % LM = Percentage Lean Mass; DXA = Dual-energy X-ray Absorptiometry;

Outcome	Study	Summary of findings	Effect estimates
Cancer specific mortality	Friedenreich et al. 2016	No significant associations with prostate cancer mortality	HR (95% CI) 0 h/w 1.00 (ref) >0 – 2.4 h/w 0.67 (0.40, 1.11) 2.4 – 7.9 h/ w 0.94 (0.59, 1.52) > 7.9 h/w 0.66 (0.37, 1.18)
	Schmid et al. 2018	No significant associations with renal cell cancer mortality	HR (95% CI) 0 – 2 h/d 1.00 (ref) >2 – 4 h/d 1.39 (0.68, 2.84) >4 h/d 1.03 (0.45, 2.40)
	Schmid et al. 2018	No significant associations with hematologic cancer mortality	HR (95% CI) 0 – 2h/d 1.00 >2 – 4 h/d 0.99 (0.76, 1.29) >4 h/d 1.08 1.12 (0.83, 1.52)
CVD mortality	Arem et al. 2015	No significant associations	HR (95% CI) 0-2 h/d 1.00 (ref) 2-4 h/d 1.09 (0.62, 1.90) >4 h/d 0.72 (0.36, 1.42)
	Campbell et al. 2013	No significant associations	HR (95% CI) <3hr/day 1.00 (ref) 3 – 6hr/day 1.11 (0.76, 1.62) >6hr/day 1.22 (0.73, 2.03)
QOL	D'Silva et al. 2018	Total sedentary time was inversely associated with HRQoL at the 75th percentile Sedentary time in at least 30-min bouts was inversely associated with HRQoL at the 25th, 50th, and 75th percentiles	β (95% CI) at the 25th, 50th, and 75th percentiles of: ST P25 -0.06 (−0.14, 0.01) P50 -0.08 (-0.16, 0.06) P75 -0.07 (-0.13, -0.12) ST in 30 min bouts P25 -0.06 (-0.10, -0.01) P50 -0.06 (-0.11, -0.01) P75 -0.05 (-0.09, -0.01)
	Gaskin et al. 2016	No significant associations	β (95% CI) Global Health Status -0.03(-0.11, 0.05)
	George et al. 2013	No significant associations	Adjusted LSM (SD) for quartiles of ST: Q1; Q2; Q3; Q4 Physical summary 40.6 (1.2); 40.0 (1.2); 40.2 (1.2); 40.7 (1.2) Mental summary 46.2 (1.4); 45.7 (1.4); 46.7 (1.4); 46.3 (1.4)
	George et al. 2014	There were significant associations between sedentary time and overall physical summary scores, as well as sub scores for physical functioning and general health. No other associations.	β (SE) Phys summary -0.34 (0.11) General health -0.75 (0.25) Mental summary score 0.09 (0.14)
	Hartman et al. 2017	No significant associations for total ST, short, or long ST bouts	β (SE) Phys health summary score Total ST -0.50 (0.33) Short ST bouts 0.20(0.59)

			Long ST bouts -0.49(0.32) Mental health summary score Total ST 0.23 (0.34) Short ST bouts 0.83(0.63) Long ST bouts 0.24(0.34)
	Lynch et al. 2011	Participants who watched ≥5 h of television per day had a 16% lower total quality of life score than did participants reporting ≤2 h per day.	β (SE) ≤2 h/d ref. 3-4 h/d 0.038 (0.017) ≥5 h/d 0.171 (0.028)
	Phillips et al. 2015	No significant associations	Unadjusted means (SD) for quartiles of ST Q1; Q2; Q3; Q4 116.4(16.5); 118.1(16.4); 114.6(18.6); 113.7(21.7)
	Trinh et al. 2013	No significant associations for either workday or non-workday ST	Adjusted mean (SD) per categories of: Workday ST Fact-general 0 – 5 h/d 83.0 (1.2) 5.1 – 10 h/d 84.4 (1.18) >10.0 h/d 83.4 (1.28) Non-workday ST Fact-general 0 – 5 h/d 83.6 (1.10) 5.1 – 10 h/d 82.8 (0.99) >10.0 h/d 82.8 (1.04)
	Vallance et al. 2014	No significant associations	Adjusted mean (SE) for quartiles of ST Q1; Q2; Q3; Q4 108.4 (3.0); 113.0 (2.6); 110 (2.6); 111.8 (2.8)
	Vallance et al. 2017	No significant associations in the single effects model.	β (95%CI) Single activity model ST non bouts 0.7(-0.3, 1.7) ST bouts -0.1(-0.7, 1.7)
	Van Roekel, et al. 2016a, b	No significant associations for total ST and overall QOL. Prolonged ST and longer ST duration were associated with reduced total QOL. Higher levels of ST were associated with reduced physical functioning and higher disability. Prolonged ST and longer sedentary bout duration were significantly associated with reduced physical and role functioning scores, as well as higher disability.	β(95% CI) ST, per 2 h/day GQoL -1.3 (-6.7, 4.1) Prolonged ST, per 2h/day GQoL -4.5 (-8.2, -0.9) Usual sedentary bout duration – per 15 minutes GQoL -5.0 (-8.6, -1.4)
Fatigue	D'Silva et al. 2018	Total sedentary time was inversely associated with fatigue symptoms at the 50th percentile.	β (95% CI) at the 25th, 50th, and 75th percentiles of: ST P25 -0.03 (-0.07, 0.02) P50 -0.04 (-0.07, -0.01) P75 -0.03 (-0.05, 0.03) ST in 30 min bouts P25 -0.02 (−0.05, −0.01) P50 -0.02 (−0.04, −0.01)

			P75 -0.01 (−0.04, 0.01)
	Gaskin et al. 2016	No significant associations	β (95% CI) 0.04 (-0.05, 0.12)
	George et al. 2013	No significant associations	Adjusted LSM (SD) for quartiles of ST Q1; Q2; Q3; Q4 Behavioural severity 3.7 (0.4); 3.7 (0.4); 3.6 (0.3); 3.6 (0.4) Affective meaning 4.2 (0.4); 4.5 (0.4); 4.3 (0.4); 4.3 (0.4) Sensory 5.1 (0.3); 5.2 (0.3); 4.9 (0.3); 5.1 (0.3) Cognitive 4.8 (0.3); 4.7 (0.3); 4.5 (0.3); 4.7 (0.3)
	Phillips et al. 2015	ST was significantly associated with fatigue duration but not fatigue severity or interference.	Unadjusted means (SD) for quartiles of ST Q1; Q2; Q3; Q4 Severity 2.7(1.9); 2.8(2.0); 2.9(2.2);3.1(2.1) Interference 1.5(1.8); 1.5(1.7); 1.6(2.0); 1.9(2.2) Duration 2.5(1.8); 2.8(2.1); 2.9(2.3); 3.3(2.3)
	Rogers et al. 2011	Significant, positive associations.	Adjusted means for categories of sitting Minutes sitting and fatigue ≤120: 12.5 >120 - ≤1360: 14.2 >360: 17.2
	Trinh et al. 2013	No significant associations	Adjusted mean (SD) per categories of: Workday sitting 0 – 5 h/d 121.9 (1.89) 5.1 – 10 h/d 124.3 (1.86) >10.0 h/d 121.9 (2.00) Non-workday sitting 0 – 5 h/d 122.9 (1.75) 5.1 – 10 h/d 121.3 (1.58) >10.0 h/d 120.5 (1.67)
	Trinh et al. 2015	ST was associated with fatigue when modelled alongside MVPA but not when modelled alongside LPA	R^2, β, F, p MVPA Model 0.05, 0.18, 2.35, 0.03 LPA Model 0.05, 0.41, 2.35, 0.18
	Vallance et al. 2014	No significant associations	Adjusted mean (SE) for quartiles of ST Q1; Q2; Q3; Q4 41.0 (1.9); 42.6 (1.7); 40.5 (1.7); 41.1 (1.8)
	Vallance et al. 2017	No significant associations in single effects model.	β (95%CI) Sedentary bouts -0.03 (-0.08, 0.1) Sedentary non-bouts 0.8 (0.0, 1.6)
	Van Roekel, et al. 2016a, b	Significant, positive associations	β (95% CI) Total ST, per 2 h/day 8.4 (0.5, 16.3) Prolonged ST 8.0 (2.7, 13.2) Sedentary bout duration 6.1 (0.8, 11.4)

Depression	Gaskin et al. 2016	No significant associations	β (95% CI) -0.00 (-0.04, 0.04)
	Phillips et al. 2015	No significant associations	Unadjusted means (SD) for quartiles of ST Q1; Q2; Q3; Q4 4.1(3.9); 3.7(3.5); 3.6(3.8); 4.4(4.4)
	Rogers et al. 2011	No significant associations	Adjusted means for categories of sitting ≤120: 7.2 >120 - ≤1360: 7.1 >360: 8.1
	Sabiston et al. 2017	Higher ST was associated with higher depressive symptoms.	Depression mean(SD) Low ST: 6.89(5.18) High ST: 9.50(6.07) $F(8,179) = 4.97$, $p=0.03$, $R^2=0.34$
	Trinh et al. 2015	Sedentary time was not associated with depression when modelled alongside either MVPA or LPA	R^2, β, F, p MVPA model 0.03, 0.14, 1.82, 0.08 LPA Model 0.03, 0.29, 1.82, 0.35
	Vallance et al. 2015	No significant associations	Adjusted mean (SE) across quartiles of: Q1; Q2; Q3; Q4 ST 4.2 (0.8); 2.4 (0.7); 3.9 (0.7);3.2 (0.7) ST 30 minute bouts 4.1 (0.7); 3.2 (0.7); 3.5 (0.7); 3.1 (0.7)
	Vallance et al. 2018	Significant associations at the 50th percentile of ST	B(95% CI) of ST at 25^{th}, 50^{th}, and 75^{th} percentiles of depression P25 -0.08 (-0.01, 0.02) P50 0.02 (0.00, 0.03) P75 0.08 (-0.01, 0.03)
	Van Roekel, et al. 2016	No significant associations	Single effects model β (95% CI) 0.2 (-0.2, 0.5)
Anxiety	Gaskin et al. 2016	No significant associations	β (95% CI) -0.01 (-0.05, 0.03)
	Phillips et al. 2015	No significant associations	Mean (SD) anxiety scores by baseline ST quartile Q1; Q2; Q3; Q4 4.7(3.0); 4.5(3.4); 4.5(3.4); 4.3(3.5)
	Vallance et al. 2015	No significant associations for either total ST or ST in 30 minute bouts	Adjusted mean (SE) across quartiles Q1; Q2; Q3; Q4 Total ST 18.6(0.6); 17.9 (0.5); 18.6 (0.5); 18.0 (0.5) ST 30 minute bouts 19.0(0.5); 17.9 (0.5); 18.0 (0.5); 18.4 (0.5)
	Vallance et al. 2018	No significant associations	B(95% CI) of ST at 25^{th}, 50^{th}, and 75^{th} percentiles P25 -0.01 (-0.02, 0.01) P50 -0.01 (-0.01, 0.01) P75 0.01 (-0.01, 0.01)
	Van Roekel, et al. 2016	No significant associations	β (95% CI)

			Single effects model 0.1 (-0.2, 0.5)
Distress	Van Roekel, et al. 2016	No significant associations for ST, prolonged ST, or ST duration	β (95% CI) ST, per 2 h/day −0.2 (−2.0, 1.7) Prolonged ST 0.7 (−0.5, 1.9) Sedentary bout duration 0.7 (−0.5, 2.0)
Pain	Forsythe et al. 2013	No significant associations in combined model	β (95% CI) Combined model <2.5 h/day 1.00 ≥2.5 h/day -1.31 (-3.22, 0.60)
	Gaskin et al. 2016	No significant associations	β (95% CI) -0.06 (-0.15, 0.03)
	George et al. 2013	No significant associations	Adjusted LSM (SD) for quartiles of ST Q1; Q2; Q3; Q4 44.6 (1.4) 43.7 (1.4) 44.3 (1.3) 45.3 (1.4)
	George et al. 2014	No significant associations	β (SE) -0.39 (0.24)
	Trinh et al. 2015	No independent associations when modelled MVPA or LPA.	R^2, β, F, p MVPA model 0.00, 0.06, 1.13, 0.49 LPA Model 0.01, 0.45, 1.13, 0.19
Cancer specific symptoms	Gaskin et al. 2016	No significant associations (prostate cancer symptoms)	β (95% CI) Urinary symptoms 0.01 (-0.07, 0.09) Bowel symptoms -0.01 (-0.06, 0.04) .73 Hormonal symptoms -0.01 (-0.06, 0.04) .73
	Phillips et al. 2015	No significant associations (prostate cancer symptoms)	Mean per quartile of ST Q1; Q2; Q3; Q4 Bowel functioning 91.2; 91.5; 91.2; 90.3 Urinary incontinence 80.3; 82.2; 84.1; 80.6 Urinary irritation/ obstruction 88.4; 89.4; 89.1; 88.7 Sexual functioning 30.8; 32.6; 31.3; 31.5 Vitality/ hormonal functioning 88.4; 90.2; 88.5; 87.9
	Trinh et al. 2013	No significant associations (prostate cancer symptoms)	Adjusted mean (SD) per categories of: Workday sitting 0 – 5 h/d 47.3 (0/66) 5.1 – 10 h/d 47.8 (0.65) >10.0 h/d 47.8 (0.70) Non-workday sitting 0 – 5 h/d 47.9 (0.62) 5.1 – 10 h/d 46.5 (0.56) >10.0 h/d 46.5 (0.59)
	Vallance et al.	No significant associations (colon	Adjusted mean (SE) for quartiles of ST

	2014	cancer)	Q1; Q2; Q3; Q4 22.3 (0.7); 24.0 (0.6); 22.8 (0.6); 23.0 (0.6)
BMI	Boyle et al. 2017	No significant associations in single effects model. In isotemporal substitution models, replacing prolonged sedentary time with non-prolonged sedentary time was associated with lower BMI.	Single effects β (95% CI) Prolonged sedentary 0.21 (0.00, 0.41) Non-prolonged sedentary -0.39 (-0.70, -0.09)
	Howell et al. 2018	No significant associations	Per 10% increase in daily ST: β (SE) 0.18 (0.38)
	Lynch et al. 2010	No significant associations	β (95% CI) 0.412 (-0.811, 1.636)
	Wijndaele et al. 2009	At both follow-up time points, there was a significant increase in mean BMI for participants reporting ≥5 h/day of television viewing compared to those watching ≤3 h/day at baseline	β (95% CI) 24 months post diagnosis <3 h/d 1.00 (ref) 3-4.9 h/d 0.15 (-0.12, 0.42) ≥5 h/d 0.71 (0.31, 1.11) 36 months post diagnosis <3 h/d 1.00 (ref) 3-4.9 h/d 0.20 (-0.11, 0.52) ≥5 h/d 0.61 (0.14, 1.07)
WC	Boyle et al. 2017	No significant associations in single effects model. In isotemporal substitution models, replacing 30 minutes of prolonged ST with non-prolonged time was associated with lower WC	Single effects β (95% CI) Prolonged ST 0.19 (-0.29, 0.66) Non-prolonged ST -1.12 (-1.80, 0.44)
	Howell et al. 2018	No significant associations	Per 10% increase in daily ST: β (SE) 0.26 (0.84)
	Lynch et al. 2010	No significant associations	β (95% CI) 2.687 (-0.537, 5.910)
	Lynch et al. 2011	No significant associations	β (95% CI) 0.678 (-1.389, 2.745) p = 0.498
% LM	Howell et al. 2018	An increase in ST was associated with a decrease in percentage of lean mass.	Per 10% increase in daily ST: β (SE) -1.01 (0.40)
WHR	Howell et al. 2018	WHR did not change with % time spent sedentary, but those that reported ≥5h/d of screen time had a higher WHR compared to those who reported ≤2h/d.	Per 10% increase in daily ST: β (SE) <0.01 (0.01)